APPENDIX A

ITS USER SERVICES SUMMARY

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APPENDIX B

ITS EARLY DEPLOYMENT PROJECT PROSPECTUSES

This appendix contains the individual project prospectuses identified in the draft Seattle to Portland ITS Corridor Plan. These projects included in this appendix by plan area are listed below. Figure B-1 provides the location of each project in the corridor.

EARLY DEPLOYMENT PROJECTS

Plan Area	Project Title
CORRIDOR-WIDE SYSTEMS	
CVO Applications	Deploy Corridor Wide Automated Electronic Vehicle Clearance
Enforcement Applications	Demonstrate ITS Enforcement Concepts
PUGET SOUND REGION	
Travel & Transportation Management	Develop and Deploy WSDOT Northwest Region Traffic Related Information System
	Develop and Deploy WSDOT Olympic Region Traffic Related Information System
	Deploy WSDOT Seattle-Portland Traffic Related Information System
	Develop and Deploy Olympic Area SC&DI System
	Develop East King County ATMS
	Develop South King County ATMS
	Develop Pierce County ATMS
	Demonstrate Work Zone SC&DI System
Travel Demand Management	Develop Regional Multimodal Traveler Information Center
	Pilot Intermodal Terminal Information Kiosks
	Demonstrate Employer Based Multimodal Traveler Information System
Port Access	Demonstrate Port ATMS Concept
INTERCITY	Demonstrate Rural SC&DI System in Centralia/Chehalis Area
	Deploy US 30 Route Diversion
	Pilot Rest Stop Information Kiosks
PORTLAND - VANCOUVER REGION	
Travel & Transportation Management	Develop and Deploy WSDOT Southwest Region Traffic Related Information System
	Develop and Deploy WSDOT Southwest Region SC&DI System
	Deploy Ice Detection System

Project Title: Deploy Corridor Wide Automated Electronic Vehicle Clearance

User Services: Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance

Commercial Vehicle Operations:
- Commercial Vehicle Electronic Clearance
- Commercial Vehicle Administrative Processes

Time Frame: Near-Term

Objective: The primary objective of this project is to decrease the time required for performing the regulatory checks at weigh stations along Interstate 5 and reduce the number of manual checks. Use of ITS technology can eliminate the requirement for pre-approved commercial vehicles to stop at these weigh stations and increases the number of vehicles that can be checked for with current staff.

Project Background and Needs: Interstate 5 serves as the primary highway connection between Seattle and Portland and is part of the major interstate route which runs from Canada to Mexico along the west coast of the United States. Between Seattle and Portland, there are five weigh stations - three northbound and two southbound. All currently have static scales and are staffed by Washington State Patrol personnel. This corridor carries a significant amount of truck traffic. For the six month period beginning January 1, 1994, about 828,900 trucks traveled across the scales at these stations. Truck percentages range from 6.3 percent to as much as 30.2 percent of the total traffic using the corridor. Data collected at the Kelso Weigh Station for the 1991 Washington Ports and Transportation Systems Study shows that between 25 percent and 35 percent of all trucks are overweight. Overweight trucks cause increased pavement wear and are often a safety concern as well.

Many weigh stations experience periodic congestion caused by trucks arriving faster than they can be processed. This backlog forces trucks to stop and wait on the ramps leading to the scale house. Where truck volumes are high relative to the processing time, the queue of waiting trucks can extend closed to, or on to, the main highway, interfering with highway operation and safety. To avoid creating hazardous queues, the station either shuts down the station's operation until the queue of trucks

has been reduced, or shortens the processing time allocated each vehicle.

The public and private sectors look to advanced technology to increase safety and speed and improve productivity and regulatory compliance. Washington was one of the participants in the first FHWA sponsored operational test of a CVO application under the multi-state Heavy vehicle Electronic License Plate (HELP) program. The Crescent Demonstration Project deployed WIM, AVI, and automatic vehicle classification (AVC) at over 40 sites from British Columbia along I-5 through California and then eastward along I-10 into Texas. Nearly 4,200 trucks were equipped with AVI devices during the demonstration period. The project confirmed to both the public and private sectors the utility of allowing AVI equipped commercial vehicles to have their safety status, credentials and weight checked at mainline speeds. Vehicles within the weight limits and with proper credentials could then by-pass the weigh stations without stopping. A quasi-public institution called HELP, Inc. has been formed to market this and other CVO services to the trucking industry for a fee. The initial mainline pre-clearance are being installed at several California weigh stations.

Currently, the following four state agencies regulate CVO in Washington:

- Washington State Department of Licensing (WSDOL);
- Washington State Department of Transportation (WSDOT);
- Washington State Patrol (WSP); and
- Washington Utilities and Transportation Commission (WUTC).

Statement of Deficiency:

The following problem areas have been identified about the current operation of weigh stations along the I-5 corridor:

- congestion at weigh stations;
- delays to trucks at weigh stations;
- administrative complexity;
- limited staffing levels
- competitive advantage for non-compliance or non-participation;
- complexity of driver responsibilities;
- the increasing consumer orientation of the business; and
- the effectiveness of safety programs.

Project Description:

This project would use weigh-in-motion (WIM) and automatic vehicle identification (AVI) technology at corridor weigh stations to allow AVI equipped commercial vehicles to have their credentials, safety status and weight checked for compliance at highway speeds. Commercial vehicles that are legal and safe would be allowed to by-pass these weigh stations. Relevant registration, taxation and safety status information from the four Washington state agencies and three federal agencies having jurisdiction over specific aspects of commercial vehicle matters would need to be accessible at the weight stations to provide this service. Electronic Data Interchange (EDI) of this status information would be required.

The technologies and supporting systems required to implement this project have been successful during the Crescent Demonstration Project under the Heavy vehicle Electronic License Plate (HELP) effort.

In mainline preclearance, a truck equipped with a communication device called a transponder is uniquely identified with AVI equipment as a weigh station is approached. The truck also passes over a WIM sensor imbedded in the pavement which weighs the truck and determines its configuration as it travels at highway speed. This information is checked against a central database to assure that the operating credentials are in order, necessary permits have been issued, required filings have been made, weight is within declared limits, a recent safety inspection has been performed and the carrier's safety and enforcement record is good. If these criteria are not met, the driver is signaled to enter the weigh station. If the criteria are met, the driver is signaled to proceed with entering the weigh station.

System Capabilities:

The proposed electronic credential verification system will have the following three key capabilities:

- Ability to identify and weigh participating commercial vehicles at highway speeds;
- Ability to signal participating vehicles to enter or by-pass the weigh station; and
- Ability to automatically update credentials from the relevant regulatory agencies.

Project Scope: The project will be divided into two phases: development of an implementation plan and implementation of the program. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Implementation Plan

The planning effort will consist of the following activities:

1. Convene a working group of the four primary agencies, HELP, Inc., and the motor carrier industry to determine the scope and definition of a electronic vehicle clearance program for Washington State.

2. Account for CVO programs in other states and the required interfaces.

3. Define roles and responsibilities of each organization including installation, operational and maintenance duties. Determine the potential role of third party, such as HELP, Inc. in the program.

4. Determine functional specifications for the program including AVI requirements and mechanism for obtaining for credential information

5. Reach consensus among the working group and approval from required regulatory agencies.

6. Prepare a detailed work plan for system implementation.

Phase 2: Implementation

During the second phase of this project, the clearance system would be implemented. The major tasks will include the following:

1. Prepare system design documentation including computer, hardware and equipment requirements.

2. Prepare field equipment installation design documentation.

3. Design and develop EDI software for the automated updating of credentials.

4. Develop recruitment and transponder distribution plan.

5. Install, test and integrate computer software, hardware, communications, and field equipment.

6. Train weigh station personnel.

7. Distribute transponders.

8. Begin program and evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the capital costs in 1995 dollars for the Corridor Wide Automated Electronic Commercial Vehicle Clearance system. The estimate is for the base system which was described above and does not include expansions or upgrades. It is also assumed the program participants would pay for the transponders in a manner to be defined during implementation planning. The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Maintenance cost is estimated at 25 percent of the capital cost due to experience with WIM installation. Operational costs include staff requirements for the distribution of transponders and ensure the smooth communication of the data required for electronic clearance. The cost of operations might be offset by user fees, but this decision would be made during implementation planning.

Total Capital Cost =	$2,250,000
Maintenance Cost/Year =	$562,500
Operating Cost/Year =	$225,000

Project Benefits: The project is expected to benefit private motor carriers, state regulatory agencies, and the general public. The savings to the carriers are based upon the waiting time and operating costs saved by using the automated electronic vehicle clearance system. and the potential revenue lost by not using this system. A survey of California trucking firms conducted by HELP, Inc. revealed that 75% of responders estimated the cost of a truck stopping at a weigh station at $15.00. Assuming conservatively that 25% of the 1.6 million trucks now stopping at the weigh stations participate in program, the projected annual savings would be $6.1 million. Administrative savings, reduced costs due to overweight trucks, and additional revenue from fines because more trucks are weighed is not included in the benefit total at this time.

Project B/C Ratio: The benefit/cost ratio is based on a 20 year amortization of capital and O&M costs and the reduced costs to motor carriers in operating costs. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS plan.

Equivalent Uniform Annual Cost	$953,100
Annual Benefits	$6,072,368
Benefit/Cost Ratio	6.37

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). The planning phase (phase 1) of the project would be completed one year after award. The implementation phase (phase 2) would be completed two years after award.

Item	Unit Cost (1995 $)	# Units	Total Costs (1995 $)
Planning Study	$100,000	1	$100,000
Weigh Station Installation	$350,000	5	$1,750,000
System Deployment	$400,000	1	$400,000
Total Implementation Costs			$2,250,000
Maintenance Cost/Year			$562,500
Operations Cost/Year			$225,000
Equivalent Uniform Annual Cost			$953,100

Table 1: Cost Summary

Project Title: Demonstrate ITS Enforcement Concepts

User Services: Traffic Management
Incident Management
Traffic Control
Enforcement

Time Frame: Near-Term

Objective: The objective of this project is to identify and demonstrate potential ITS-based enforcement concepts

Project Background and Need: The support of highway regulatory enforcement activity is not considered an ITS user service under the current FHWA definitions. However, enforcement action statistics for the Seattle to Portland corridor along I-5 indicate the significant amount of effort is required by Washington State Police (WSP) and other response agencies. For example, 1.2 citations are issued by WSP per mile per day; 3.4 assists/calls are made occur per mile per day; in rural areas, there are an average of 33 annual accidents per mile; and in urban areas, there are an average of 238 annual accidents per mile. ITS technology could provide potential solutions to augment WSP enforcement efforts and allow enforcement personnel to focus on priority assignments.

Statement of Deficiency: Washington State Patrol is primarily responsible for the enforcement of traffic regulations along I-5. Enforcement is required to ensure the safety of all travelers using this highway facility. The amount of enforcement related activity is significant along I-5 requiring a significant commitment of resources that may be useful in other tasks.

Project Description and System Capabilities: The project will first explore potential concepts for using ITS technology to assist in the enforcement of traffic regulations. Areas to be considered include:

- automated speed enforcement where speeders are identified by radar and an image of the vehicle is captured for later processing;
- video based tracking technology which can identify vehicles that are traveling erratically and could indicate an impaired driver;

- automatic vehicle classification and video image processing to enforce HOV violations;

- AVI equipped trucks combined with WIM to identify overweight trucks; and

- emission sensors to detect seriously offending vehicles.

Based upon this assessment, the most promising concepts would be selected for demonstration testing to determine their true potential in field operations. Potential demonstration sites include I-5 in the Puget Sound Region, I-5 in the Centralia and Kelso areas, and I-5 and I-205 in the Vancouver area.

Project Scope: The scope of work consists of two phases. The first phase involves the identification, and design of the demonstration project. The second phase is the demonstration and evaluation of the most promising concepts. The tasks for each phase are as follows:

Phase 1: Concept Development and Design of Demonstrations

1. Develop concepts and ideas for using ITS technology for enforcement purposes.

2. Determine technical, legal, operational, and cost feasibility of each concept.

3. Select and gain consensus on which concepts to demonstrate.

4. Develop scope of work for the demonstration.

5. Develop partnerships with private industry to provide product prototypes and conduct the product demonstration.

Phase 2: Demonstration and Evaluation

1. Install field and office hardware, software and equipment.

2. Develop a testing planning including measures of effectiveness and identify data collection requirements.

3. Conduct the evaluation study and develop recommendations for follow-on deployment work.

Project Cost: Table 1 presents a summary explanation of the project cost in 1995 dollars.

Total Cost = $300,000

Project Benefits: The project benefits will be reflected in the evaluation and testing of systems using advanced technology to reduce the cost of enforcement along I-5 from Seattle to Portland. Depending on the effectiveness of the concepts, the applications may vary from speed enforcement to HOV lane enforcement. The project will determine the potential benefits in deploying these systems. The cost effectiveness of field deployment will then be able to be determined.

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). The concept development of demonstration will be completed eight (8) months after award. The demonstration and evaluation of the concepts will be completed eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Phase 1: Research & Development Cost	$75,000	1	75,000.00
Phase 2			
System Costs	$250,000	1	250,000.00
Evaluation	$50,000	1	50,000.00
Private Contribution to Demonstrations	($75,000)	1	-75,000.00
Total Project Cost	-	-	300,000.00

Table 1: Cost Summary

Project Title:	Develop and Deploy WSDOT Northwest Region Traffic Related Information System
User Services:	Travel and Transportation Management En-Route Driver Information Traveler Services Information Travel Demand Management Pre-Trip Travel Information Demand Management and Operations
Time Frame:	Near Term
Objective:	To develop a traffic related event-based Advanced Traveler Information System (ATIS), and deploy it in the Northwest Region along the I-5 Corridor.
Project Background and Need:	Advanced Traveler Information Systems have proven to be one of the most effective ITS tools for managing traffic, reducing congestion, delay, fuel consumption and emissions, and improving safety. This is achieved by informing travelers of the location of incidents, construction and traffic congestion in order to allow travelers to choose alternative routes, modes or departure times. Currently there exists within the Northwest Region along the corridor a number of sources of traffic related event information such as incident reports, construction and maintenance activities, traffic congestion and location of detours. While some of this information is distributed to the public through variable message signs (VMS), highway advisory radio (HAR) and media reports, much of it is used for internal agency purposes only and/or is not readily accessible by the public. There is therefore a need to develop a system that can collect and aggregate these various sources of information in order to provide travelers with a comprehensive, single source of traffic related information that can be accessed on a pre-trip or en-route basis using a variety of means and technologies. In addition, such a system would provide a consistent basis for defining traffic events, further improving the value of the information to the public, other transportation agencies and commercial vehicle operations.
Statement	The management of traffic in a congestion area, in a work zone, or

of Deficiency: at an incident location requires the timely transmission of event related traffic information to travelers on a pre-trip and en-route basis. Limited access to current traffic event related information hinders the ability to manage traffic in these areas which results in increased congestion levels, decreased mobility, and a subsequent impairment of traffic safety.

Project Description: This project would involve the development and deployment of a system to collect, process, format and disseminate traffic related information for the Northwest Region. This information could also be consolidated and filtered to provide input to a comprehensive corridor or statewide information system.

Development, implementation, integration and operations costs will be minimized by developing a similar system for all three Regions. This project will include the system design and will expand, enhance and provide long-term support for the Internet-based system developed by the Northwest Region Traffic System Management Center and the University of Washington.

System Capabilities: The Traffic Related Traveler Information System will manually or electronically gather traffic related event information such as:

- accident and incident reports from such sources as cellular phone or other call-ins, police dispatch, WSDOT mobile vehicles and the bridge tenders;
- pre-planned road closure, construction and maintenance information;
- emergency road closure, construction and maintenance information;
- truck or hazardous material restrictions;
- reversible lane operations;
- traffic speed and congestion information from SC&DI systems;
- weather conditions;
- information on planned recreational events or other activities that may disrupt traffic flow or require traffic re-routing.

All information inputs will need to be geocoded using a common referencing system such as latitude-longitude, highway milepost or major street-cross street.

Information will be stored in a relational database, running as an application on a desktop PC using a multi-tasking operating system such as Windows NT. Maximum use of commercial off-the-shelf (COTS) software, coupled with a modular design approach, will allow for a system that is expandable (both functionally and geographically) and transportable to other applications or to new hardware platforms.

The system will be designed to disseminate the traffic related event information through existing and planned WSDOT motorist information devices (i.e. VMS, HAR and media interfaces). Information dissemination capabilities may also be expanded to include new devices such as:

- automatic fax transmission to WSDOT maintenance yards, commercial radio and television stations, and other public and/or private users in need of regular traffic reports. Subscribers to the fax service would be able to define the type of information they want, the geographical area, the highways and the times (including immediate response) at which faxes should be sent. It would also be possible to charge for this service, which would be part of the subscribers data base.

- alphanumeric pager messages to WSDOT operations and maintenance staff and emergency services;

- a public dial-up information line providing computer-generated voice messages. The messages could be structured so that they can be accessed by the highway name for selected geographical areas (e.g. I 5 FROM TACOMA TO SEATTLE);

- linkages to traveler information kiosks;

- computer data feeds to both public and private users through Internet and/or direct dial-up lines;

- data feeds to mobile units using data formats such as International Traveler Information Interchange Standards (ITIS) over radio based communications including subcarrier, CDPD or data broadcast radio;

- electronic data interfaces to value added re-sellers including HELP Inc. for redistribution of the information to truckers along the corridor.

It is expected that this system will be installed in the TSMC and integrated with current traffic management operations. Terminal feeds from regional maintenance yards and the tunnel operation would also be provided to allow remote access throughout the Region.

Project Scope: Work activities will be divided into 3 phases including:

Phase 1 - Developing the Traffic Related Traveler Information System.

Phase 2 - Deploying and configuring system for the Northwest Region.

Phase 3 - Facilitating a communications link to the Seattle-Portland Traffic Related Traveler Information System.

This work will not include the deployment of traveler information devices (e.g. VMS, HAR, information kiosks, etc.) in the field. It is expected that these will be installed as part of other initiatives.

It is expected that the design and development of the traffic related traveler information system for the Northwest Region will form the core design for all Regions in the corridor. As such, this project must be initiated before any other Regional Traffic Related Traveler Information System.

<u>Phase 1 - Traffic Related Traveler Information System Development</u>

System development and testing will include:

1. Preparation of a functional design report describing the overall system design and requirements.

2. Detailed design of the software applications to support the functional requirements.

3. Development of all new software applications.

4. Development of hardware/software interfaces to the TSMC central computer.

5. Development of hardware/software interfaces to external users (e.g. media interfaces, BBS or Internet access, etc.).

6. Establishing interagency agreements with each major public and private user agency.

Phase 2 - Deployment in the Northwest Region

1. Hardware and software procurement.

2. Coding and testing of all new software applications.

3. Testing of hardware/software interfaces to the TSMC central computer.

4. Testing of hardware/software interfaces to external users.

5. Overall system testing, configuration and integration.

6. Preparation of design, operations and maintenance manuals;

7. Training of operations staff.

Phase 3 - Integration with Seattle-Portland Traffic Related Information System

This third phase would facilitate a communications link to the Seattle-Portland Traffic Related Traveler Information System Center to assist in providing corridor wide traveler information coverage. This activity could be done concurrently with system deployment of the corridor-wide system, or could be deferred until sufficient experience is gained with stand-alone operation in this Region.

As part of the Northwest Region development, the following tasks are required to integrate the system with the other regions and the corridor-wide system:

1. Preparation of a system design report;

2. Procuring additional software/licenses for the digital maps or GIS to provide corridor wide coverage.

3. Preparing inter-Regional agreements for the sharing and exchange of information, including establishing levels of access.

4. Modifying existing external agency agreements as required to provide corridor information, and establishment of new agreements with agencies having a corridor focus (e.g. private CVO firms).

5. Establishing system-to-system data communications links using the Internet-based corridor system architecture.

6. Modifying system software as required to support corridor wide information collection and dissemination.

7. Update of design, operations and maintenance manuals;

8. Training of operations staff.

Project Cost: Estimated project costs are described in Table 1 and are summarized below. The costs include the software development and limited hardware procurement. These costs do not include additional field equipment such as VMS's, pagers, kiosks, etc. It is expected that these will be provided as part of other initiatives.

It is assumed that the system will be staffed by two full-time equivalent performing both operations and maintenance. It is assumed that the operations and maintenance is 20% of the capital cost. It is assumed that communications will be provided through existing resources (i.e. SCAN or radio).

Total Capital Cost	$960,000
Annual O&M	$192,000

Project Benefits: The Statewide IVHS Plan identified the potential benefits of ATIS in the Central Puget Sound area at approximately $29,000,000 per

year. The Northwest Region represents roughly 70% of the vehicle-miles traveled within the Central Puget Sound area. Assuming that 5% of these benefits can be achieved through deployment of the Regional Traffic Related Information System, the annual benefits for the Northwest Region can be estimated as:

Annual Benefits	$1,015,000

Project B/C: The benefit/cost ratio is based on a 20-year amortization of capital and O&M costs, and the pro-rated ATIS benefits computed in the Statewide IVHS Plan. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS Plan.

Equivalent Uniform Annual Costs	$262,656
Annual Benefits	$1,015,000
Benefit/Cost Ratio	3.9:1

Project Schedule: The Northwest Region Traffic Related Information System is proposed as a high-priority near-term project (0-6 years time frame). The system development would be completed in eighteen (18) months after award. The system deployment would be completed two (2) years after award.

It is expected that the system design and deployment of the system in the Northwest Region be completed first. Deployment of similar system in the Southwest and Olympic Regions is contingent upon the successful deployment in the Northwest Region. The three systems are expected to be integrated into a corridor-wide system after all three systems have been deployed.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
System Development	600,000	1	600,000
System Deployment	200,000	1	200,000
Total Construction. Cost	-	-	800,000
Design/Evaluation Cost	-	-	160,000
Total Capital Cost	-	-	960,000
O & M Cost/Year	-	-	192,000

Table 1: Cost Summary

Project Title:	Develop and Deploy WSDOT Olympic Region Traffic Related Information System
User Services:	Travel and Transportation Management En-Route Driver Information Traveler Services Information Travel Demand Management Pre-Trip Travel Information Demand Management and Operations
Time Frame:	Near Term
Objective:	To develop a traffic related event-based Advanced Traveler Information System (ATIS), and deploy it in the Olympic Region along the I-5 Corridor.
Project Background and Need:	Advanced Traveler Information Systems have proven to be one of the most effective ITS tools for managing traffic, reducing congestion, delay, fuel consumption and emissions, and improving safety. This is achieved by informing travelers of the location of incidents, construction and traffic congestion in order to allow travelers to choose alternative routes, modes or departure times. Currently there exists within the Olympic Region along the corridor a number of sources of traffic related event information such as incident reports, construction and maintenance activities, traffic congestion and location of detours. While some of this information is distributed to the public through variable message signs (VMS), highway advisory radio (HAR) and media reports, much of it is used for internal agency purposes only and/or is not readily accessible by the public. There is therefore a need to develop a system that can collect and aggregate these various sources of information in order to provide travelers with a comprehensive, single source of traffic related information that can be accessed on a pre-trip or en-route basis using a variety of means and technologies. In addition, such a system would provide a consistent basis for defining traffic events, further improving the value of the information to the public, other transportation agencies and commercial vehicle operations.
Statement	The management of traffic in a congestion area, in a work zone, or

of Deficiency: at an incident location requires the timely transmission of event related traffic information to travelers on a pre-trip and en-route basis. Limited access to current traffic event related information hinders the ability to manage traffic in these areas which results in increased congestion levels, decreased mobility, and a subsequent impairment of traffic safety.

Project Description: This project would involve the development and deployment of a system to collect, process, format and disseminate traffic related information for the Olympic Region. This information could also be consolidated and filtered to provide input to a comprehensive corridor or statewide information system. For example, a Traffic Related Traveler Information System will be developed to facilitate coordination between this region with both the Southwest and Northwest Regions.

Development, implementation, integration and operations costs will be minimized by developing a similar system for all three Regions in the Northwest Region project. Only minor custom tailoring and configuring for this Region would be required to accommodate Region-specific information sources, dissemination methods and operational strategies.

System Capabilities: The Traffic Related Traveler Information System will manually or electronically gather traffic related event information such as:

- accident and incident reports from such sources as cellular phone or other call-ins, police dispatch, WSDOT mobile vehicles and the bridge tenders;
- pre-planned road closure, construction and maintenance information;
- emergency road closure, construction and maintenance information;
- truck or hazardous material restrictions;
- reversible lane operations;
- weather conditions;
- information on planned recreational events or other activities that may disrupt traffic flow or require traffic re-routing.

All information inputs will need to be geocoded using a common referencing system such as latitude-longitude, highway milepost or

major street-cross street.

Information will be stored in a relational database, running as an application on a desktop PC using a multi-tasking operating system such as Windows NT. Maximum use of commercial off-the-shelf (COTS) software, coupled with a modular design approach, will allow for a system that is expandable (both functionally and geographically) and transportable to other applications or to new hardware platforms.

The system will be designed to disseminate the traffic related event information through existing and planned WSDOT motorist information devices (i.e. VMS, HAR and media interfaces). Information dissemination capabilities may also be expanded to include new devices such as:

- automatic fax transmission to WSDOT maintenance yards, commercial radio and television stations, and other public and/or private users in need of regular traffic reports. Subscribers to the fax service would be able to define the type of information they want, the geographical area, the highways and the times (including immediate response) at which faxes should be sent. It would also be possible to charge for this service, which would be part of the subscribers data base.

- alphanumeric pager messages to WSDOT operations and maintenance staff and emergency services;

- a public dial-up information line providing computer-generated voice messages. The messages could be structured so that they can be accessed by the highway name for selected geographical areas (e.g. I-5 FROM TACOMA TO SEATTLE);

- linkages to traveler information kiosks;

- computer data feeds to both public and private users through Internet and/or direct dial-up lines;

- data feeds to mobile units using data formats such as the International Traveler Information Interchange Standards (ITIS) over radio based communications including subcarrier, CDPD or data broadcast radio;

- electronic data interfaces to value added re-sellers including HELP Inc. for redistribution of the information to truckers along the corridor.

For this Region, it is anticipated that the system will be initially integrated into existing traffic engineering and/or roadway maintenance operations. Terminal feeds from regional maintenance yards would also be provided to allow remote access throughout the Region.

Project Scope: Work activities will consist of two phases:

Phase 1 - Deploying and configuring the Traffic Related Traveler Information System in the Olympic Region.

Phase 2 - Facilitating a communications link to the Seattle-Portland Traffic Related Traveler Information System.

This work will not include the deployment of traveler information devices (e.g. VMS, HAR, information kiosks, etc.) in the field. It is expected that these will be installed as part of other initiatives.

It is expected that the design and development of the traffic related traveler information system for the Northwest Region will form the standard for all Regions in the corridor. As such, this project must begin after the completion of the first phase of the Northwest Region project.

<u>Phase 1 - Deployment in the Olympic Region</u>

Upon successful development and testing of the traffic related event information system in the Northwest Region, the system would be deployed and modified in the Olympic Region. Major work activities in this Region will include:

1. Preparation of a functional design report describing aspects of the Northwest Region system that need to be tailored for application in the Olympic Region;

2. Detailed design of modifications to the Northwest Region system software elements to support deployment in the Olympic

Region;

3. Hardware and software procurement/additional license agreements;

4. Modification or development, coding and testing of modified or new software applications.

5. Modification and testing of hardware/software interfaces to existing WSDOT systems (e.g. VMS).

6. Development and testing of new hardware/software interfaces to external users. Application or modification of interagency agreements developed for the Northwest Region to each major external user;

7. Overall system testing and integration.

8. Update of design, operations and maintenance manuals;

9. Training of operations staff.

Phase 2 - Integration with Seattle-Portland Traffic Related Information System

This second phase would facilitate a communications link to the Seattle-Portland Traffic Related Traveler Information System Center to assist in providing corridor wide traveler information coverage. This activity could be done concurrently with system deployment of the corridor-wide system, or could be deferred until sufficient experience is gained with stand-alone operation in this Region.

Requirements and provisions for providing corridor wide information will have been considered under the Northwest Region system core design. Work under this phase will consist mainly of relatively minor software and/or hardware modifications including:

1. Preparation of a system design report;

2. Procuring additional software/licenses for the digital maps or GIS to provide corridor wide coverage.

3. Preparing inter-Regional agreements for the sharing and exchange of information, including establishing levels of access.

4. Modifying existing external agency agreements as required to provide corridor information, and establishment of new agreements with agencies having a corridor focus (e.g. private CVO firms).

5. Establishing system-to-system data communications links using the Internet-based corridor system architecture.

6. Modifying system software as required to support corridor wide information collection and dissemination.

7. Update of design, operations and maintenance manuals;

8. Training of operations staff.

Project Cost: Estimated project costs are described in Table 1 and are summarized below. The costs include the software development and limited hardware procurement. These costs do not include additional field equipment such as VMS's, pagers, kiosks, etc. It is expected that these will be provided as part of other initiatives.

It is assumed that the system will be staffed by one full-time equivalent performing both operations and maintenance. It is assumed that the operations and maintenance is 20% of the capital cost. It is assumed that communications will be provided through existing resources (i.e. SCAN or radio).

Total Capital Cost	$180,000
Annual O&M	$36,000

Project Benefits: The Statewide IVHS Plan identified the potential benefits of ATIS in the Central Puget Sound area at approximately $29,000,000 per year. The Olympic Region represents 30% of the vehicle-miles traveled in the Central Puget Sound. Assuming that 5% of these benefits can be achieved through deployment of the Regional Traffic Related Information System, the annual benefits for the Olympic Region can be estimated as:

Annual Benefits	$435,000

Project B/C: The benefit/cost ratio is based on a 20-year amortization of capital and O&M costs, and the pro-rated ATIS benefits computed in the Statewide IVHS Plan. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS Plan.

Equivalent Uniform Annual Costs	$49,248
Annual Benefits	$435,000
Benefit/Cost Ratio	8.8:1

Project Schedule: The Olympic Region Traffic Related Information System is proposed as a high-priority near-term project (0-6 years time frame). The system development would be based core system design developed for the Northwest Region Traffic Related Information System. System development would be completed in six (6) months after award. The system deployment would be completed one (1) year after award.

It is expected that the system design and deployment of the system in the Northwest Region be completed first. Deployment of similar system in the Southwest and Olympic Regions is contingent upon the successful deployment in the Northwest Region. The three systems are expected to be integrated into a corridor-wide system after all three systems have been deployed.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
System Deployment	150,000	1	150,000
Total Construction. Cost	-	-	150,000
Design/Evaluation Cost	-	-	30,000
Total Capital Cost	-	-	180,000
O & M Cost/Year	-	-	36,000

Table 1: Cost Summary

Project Title:	Deploy WSDOT Seattle-Portland Traffic Related Information System
User Services:	Travel and Transportation Management En-Route Driver Information Traveler Services Information Travel Demand Management Pre-Trip Travel Information Demand Management and Operations
Time Frame:	Near Term
Objective:	To develop a common traffic related event-based Advanced Traveler Information System (ATIS) that facilitates the information interchange between the Northwest, Southwest and Olympic Regional Traffic Related Traveler Information Systems. In this way, a corridor-wide traveler information system will be created by coordinating the functions of existing systems in neighboring regions.
Project Background and Need:	Advanced Traveler Information Systems have proven to be one of the most effective ITS tools for managing traffic, reducing congestion, delay, fuel consumption and emissions, and improving safety. This is achieved by informing travelers of the location of incidents, construction and traffic congestion in order to allow travelers to choose alternative routes, modes or departure time. Currently there exists within each of the Regions along the corridor a number of sources of traffic related event information such as incident reports, construction and maintenance activities, traffic congestion and location of detours. While some of this information is distributed to the public through variable message signs (VMS), highway advisory radio (HAR) and media reports, much of it is used for internal agency purposes only and/or is not readily accessible by the public. Regional traveler information systems will be deployed to address this issue and will perform as a comprehensive, single source of traffic related information that can be accessed on a pre-trip or en-route basis using a variety of means and technologies. As many trips within the I-5 Portland to Seattle corridor travel across the borders between WSDOT regions, the pre-trip planning

benefits of these systems will be lost on these travelers as access to the information does not extend beyond the regional boundaries. To address this issue and assist travelers that cross regional boundaries, a Seattle-Portland Traffic Related Traveler Information System should be developed to facilitate the corridor-wide traveler information from the existing facilities provided by the regional traveler information systems.

Statement of Deficiency

The management of traffic in a congestion area, in a work zone, or at an incident location requires the timely transmission of event related traffic information to travelers on a pre-trip and en-route basis. Limited access to current traffic-event related information hinders the ability to manage traffic in these areas, with the result that congestion levels are increased, mobility is decreased, and safety is impaired.

Project Description:

This project would involve the development and deployment of a system to facilitate information exchange between the proposed regional traveler information systems in order to provide corridor-wide traveler information through the facilities proposed to be present under the regional systems.

Development, implementation, integration and operations costs will be minimized by developing a "baseline" or "core" system common to all three Regions in the Northwest Region project that anticipates the implementation of this project. This project will provide a data management system that will retrieve filtered data from each of the regional traveler information systems and disseminate this information to the neighboring systems.

System Capabilities:

The traffic related event information system will manually or electronically gather traffic related event information from each of the traveler information system such as:

- accident and incident reports from cellular phone or other call-ins, police dispatch, WSDOT mobile vehicles and the bridge tenders;
- pre-planned road closure, construction and maintenance information;
- emergency road closure, construction and maintenance information;

- truck or hazardous material restrictions;
- reversible lane operations;
- traffic speed and congestion information from SC&DI systems (currently only operational in the NW Region);
- weather conditions;
- information on planned recreational events or other activities that may disrupt traffic flow or require traffic re-routing.

All information inputs will need to be geocoded using a common referencing system throughout the corridor such as latitude-longitude, highway milepost and major street-cross street.

Information will be stored in a relational database, running as an application on a desktop PC using a multi-tasking operating system such as Windows NT. Maximum use of commercial off-the-shelf (COTS) software, coupled with a modular design approach, will allow for a system that is expandable (both functionally and geographically) and transportable to other applications or to new hardware platforms.

The system will be designed to disseminate the traffic related event information to the proposed regional traveler information systems. In turn, these systems will use existing and planned WSDOT motorist information devices (VMS, HAR, media interfaces). Information dissemination capabilities may also be expanded to include new devices such as:

- automatic fax transmission to WSDOT maintenance yards, commercial radio and television stations, and other public and/or private users in need of regular traffic reports. Subscribers to the fax service would be able to define the type of information they want, the geographical area, the highways and the times (including immediate response) at which faxes should be sent. It would also be possible to charge for this service, which would be part of the subscribers data base.

- alphanumeric pager messages to WSDOT operations and maintenance staff and emergency services;

- a public dial-up information line providing computer-

generated voice messages. The messages could be structured so that they can be accessed by the highway name for selected geographical areas (e.g. I-5 FROM TACOMA TO SEATTLE);

- linkages to traveler information kiosks;
- computer data feeds to both public and private users through Internet and/or direct dial-up lines;
- data feeds to mobile units using data formats such as the International Traveler Information Interchange Standards (ITIS) over radio based communications including, CDPD and data broadcast radio;
- electronic data interfaces to value added re-sellers including HELP Inc. for redistribution of the information to truckers along the corridor.

It is anticipated that the system will be integrated into the proposed traveler information systems for the Northwest Region. Communications between this site and the neighboring regional systems will complete the Seattle-Portland Traffic Related Traveler Information System.

Project Scope: Work activities will consist of one phase which will be timed to match the final phase of the regional traveler information systems. This work is the corridor-wide integration of the regional systems under this project. This work will not include the deployment of traveler information devices (e.g. VMS, HAR, and information kiosks) in the field. It is expected that these will be installed as part of other initiatives.

This work would involve linking together of the traffic related traveler information systems in each of the three Regions to provide corridor wide coverage. This activity could be done concurrently with system deployment in the Olympic and Southwest Regions, or could be deferred until sufficient experience is gained with stand-alone operation in the Regions.

As part of the regional traffic related information system development, requirements and provisions for providing corridor

wide traveler information will have been considered requiring only minor updates to connect to the corridor-wide system. The corridor-wide traveler information system development will include:

1. Preparation of a system design report;

2. Procuring additional software/licenses for the digital maps or GIS to provide corridor wide coverage.

3. Preparing inter-Regional agreements for the sharing and exchange of information, including establishing levels of access.

4. Modifying existing external agency agreements as required to provide corridor information, and establishment of new agreements with agencies having a corridor focus (e.g. private CVO firms).

5. Establishing system-to-system data communications links using the Internet-based corridor system architecture.

6. Modifying system software as required to support corridor wide information collection and dissemination.

7. Update of design, operations and maintenance manuals;

8. Training of operations staff.

Project Cost: The estimated project costs are described in Table 1 These costs are for the central system development and communications equipment only. This system will be co-located with a regional system and operated by the staff for that region. It is also assumed that communication costs between these systems will be covered by other resources such as SCAN.

Total Capital Costs	$480,000
Annual O&M	$48,000

Project Benefits: The Statewide IVHS Plan identified the potential benefits of ATIS in the Central Puget Sound area at approximately $29,000,000 per year, and in the Vancouver area at approximately $7,500,000 per year. Assuming that 5% of these benefits can be achieved through

deployment of the Seattle-Portland Traffic Related Traveler Information System, the annual benefits for this system can be estimated at:

Annual Benefits	$1,825,000

Project B/C: The benefit/cost ratio is based on a 20-year amortization of capital and O&M costs, and the pro-rated ATIS benefits computed in the Statewide IVHS Plan. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS Plan.

Equivalent Uniform Annual Costs	$83,328
Annual Benefits	$1,825,000
Benefit/Cost Ratio	21.9:1

Project Schedule: The Seattle-Portland Traffic Related Information System is proposed as a high-priority near-term project (0-6 years time frame). The system development based on the Northwest Region Traffic Related Information System design would be completed in six (6) months after award. The system deployment would be completed one (1) year after award.

It is expected that the system design and deployment of the system in the Northwest Region be completed first. Deployment of similar systems in the Southwest and Olympic Regions is contingent upon the successful deployment in the Northwest Region. The three systems are expected to be integrated into the Seattle-Portland Traffic Related Information System after all three systems have been deployed.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
System Deployment	400,000	1	400,000
Total Construction. Cost	-	-	400,000
Design/Evaluation Cost	-	-	80,000
Total Capital Cost	-	-	480,000
O & M Cost/Year	-	-	48,000

Table 1: Cost Summary

Project Title: Develop and Deploy Olympic Area SC&DI

User Services:

Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Travel Demand Management:
- Pre-Trip Travel Information

Public Transportation Operations:
- Public Transportation Management
- Public Travel Security

Commercial Vehicle Operations:
- Commercial Fleet Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near Term

Objective: The primary objective of this effort is to improve the safety and efficiency of people and goods movement on the urban freeway network through the deployment of a surveillance, control, and driver information (SC&DI) system in the Olympia area along Interstate 5 and US 101.

Project Background and Need: Interstate 5 serves as the primary highway connection between Seattle and Portland and is part of the major interstate route which runs from Canada to Mexico along the west coast of the United States. US 101 intersects I-5 at I-5 Exit 104 and is the primary land route to the Olympic Peninsula in northwest Washington. The Olympic Peninsula area includes Olympic National Park and numerous state parks. Exit 104 also provides access to the ocean beaches.

Congestion on I-5 and US 101 occurs in two forms: recurrent and non-recurrent. Recurrent congestion occurs when peak period traffic demand exceeds the capacity of the roadway. Non-recurrent congestion occurs when an incident reduces the capacity of a roadway by lane blockage or shoulder activity. Incidents include stalls or breakdowns, debris or spilled load on the roadway, some maintenance or construction activities, weather conditions, or special events.

The Olympic Region currently employs a number of variable message signs and has some limited vehicle detection capabilities.

Statement of Deficiency: Traveler delay, caused or exacerbated by congestion, is on the rise in the Olympia area. The potential exists for the number of lane miles of congestion to increase and travel speeds along I-5 and US 101 to decrease.

Project Description: This project would involve the development and deployment of a surveillance, control, and driver information system in the Olympia area along the I-5 corridor between SR 510 and SR 121, and along the US 101 corridor between I-5 and SR 8. The SC&DI will include new vehicle detector stations (DS), closed circuit television (CCTV) cameras, variable message signs (VMS), highway advisory radio (HAR), and ramp meter installations in the Olympia area. The control units for the signals, DS, CCTV, VMS, HAR, and ramp meters will be located at the WSDOT Olympic Region Traffic System Management Center (TSMC) in Tacoma.

System Capabilities: The proposed Olympia area SC&DI System will have the following capabilities:

- Monitor real time traffic conditions along I-5 and US 101 using the DS and CCTV systems;
- Control the Olympia area VMS and HAR to display/broadcast either pre-designed messages or other messages in response to regional traffic conditions; and
- Coordinate operations with other WSDOT TSMC's and the Washington State Patrol for regional traffic management.

Project Scope: The project will be divided into two phases: the planning and design phase, and the near-term implementation phase. Following is a brief description of the scope of work for each of the two phases.

<u>Phase 1: Planning and Design of Olympia Area SC&DI</u>
The planning and design effort will consist of the following activities:

1. Develop a master plan for SC&DI in the Olympia area similar to those currently existing for Seattle and Tacoma.

2. Design the vehicle detector system (DS) which will include developing specifications for the loops, junction boxes, controllers, cabinet, modem, detector display panel, auxiliary display panel, loop amplifiers, output/power distribution assembly, load switches, and current monitor, as well as, the display monitor and software at the TSMC. The design will include determining the exact location and designing the installation of each DS. Detector stations should be

installed at approximately one-half mile intervals along I-5 and SR 101.

3. Design a Closed Circuit Television (CCTV) system which will include developing specifications for the cameras, housing, Pan, Tilt, and Zoom (PTZ) unit and display monitors. The design will include determining the exact location and designing the mounting for each camera unit. Approximately 13 closed circuit television cameras could be installed - 1 per interchange.

4. Design a variable message sign (VMS) system. The design will include developing specifications for the signs and the head-end support system, determining the exact location of the signs, and developing a message library. The signs would be controlled from the TSMC. This effort includes converting two existing VMS to Type 170 based controllers. Six (6) variable message signs could be installed four on I-5 and the other two on US 101.

5. Design a highway advisory radio (HAR) system. This effort will include developing specifications for the antenna, control cabinet, AM transmitter, voice storage unit, relay panel, and power supply. This effort includes the developing the head-end support system, determining the exact location of the signs, and developing a message library. The HAR would be controlled from the TSMC. At least two HAR systems could be installed - one along the I-5 corridor and the other along the US 101 corridor.

6. Design the ramp-meter system. This effort will include developing specifications for the loops, signal display, warning signs and flashing beacons, control cabinet, output/power distribution assembly, as well as the display monitor and software at the TSMC. The design will also include determining the exact location and designing the ramp meter installation. Ramp meters should be installed at on-ramps along I-5 and US 101.

7. Design the communication system to interconnect the field equipment to the TSMC. The field equipment includes the DS's, CCTV's, traffic control signals, local controllers, VMS's, and HAR's, to the TSMC. The communication system includes all communication lines (except laterals), HUB stations, and power. This effort will also include designing the interface and communications systems requirements between the TSMC, Washington State Patrol, and other WSDOT TSMC's.

8. Plan for interconnections and expansion of the system to include the following:

    - interconnection to public transportation systems;
    - transit priority system;
    - CVO applications;
    - emergency notification interface;
    - WSDOT baseline advanced traveler information system;
    - weather information system;
    - port access system; and
    - regional multi-modal traveler information center.

All of these additional applications will have the standard interfaces required based on the statewide architecture adopted as part of this project. The TSMC will have the ability to display information provided by each one of these applications using the standardized interface.

Phase 2: Implementation and Evaluation of Olympia Area SC&DI

The second phase of this project is the implementation and evaluation of the Olympia area SC&DI system. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Construction of the TSMC. This effort would include purchasing and installing the TSMC's equipment;

5. Developing/customizing the software for field equipment and head-end configuration;

6. Integrating the Olympia area SC&DI system into the Puget Sound region ATMS;

7. Develop operational procedures;

8. Testing and evaluating the system; and

9. Evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the capital costs in 1995 dollars for the Olympia area SC&DI system. The estimate is for the base system which was described above and does not include the planned expansions or upgrades. The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$31,957,200
Annual O&M	$3,195,720

Project Benefits: The project benefits are expected to be a reduction in traveler delay caused by congestion and a reduction in incidents. The Statewide IVHS Plan identifies the potential benefits in the Central Puget Sound area as approximately $29,000,000 for ATIS, $45,000,000 for VMS, $26,500,000 for HAR, $63,600,000 for incident management and $68,900,000 for detection. These benefits total $233,000,000 for the entire region. The urban freeways and major roads in Thurston County represents 3% of the vehicle-miles traveled in the Central Puget Sound area which yields the following annual benefit:

Annual Benefits	$6,990,000

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform	
Annual Costs	$5,547,770
Annual Benefits	$6,990,000
Benefit/Cost Ratio	1.3:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the SC&DI system will follow in both the medium-term and long-term time frames.

The planning and design phase (phase 1) of the project would be completed two (2) years after award. The implementation phase (phase 2) would be completed six (6) years after award.

Item	Unit Cost (1995 $)	Number of Units	Total Cost (1995 $)
Data Stations	50,000	38	1,900,000
CCTV	50,000	13	650,000
VMS	178,333	6	1,070,000
HAR	83,000	2	166,000
Ramp Meters	62,500	24	1,500,000
Communication System and TSMC	18,930,000	1	18,930,000
System Expansion	805,000	3	2,145,000
Total Construction Costs			26,631,000
Design/Evaluation Cost			5,326,000
Total Capital Cost			31,957,200
O & M Cost / Year			3,195,720

Table 1: Cost Summary

Project Title: Develop East King County ATMS

User Services:

Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Travel Demand Management:
- Pre-Trip Travel Information

Public Transportation Operations:
- Public Transportation Management

Commercial Vehicle Operations
- Commercial Fleet Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near-Term to Medium-Term

Objective: To design and implement an Advanced Traffic Management System (ATMS) for the urban areas of East King County. The ATMS will provide cross-jurisdictional highway traffic monitoring, control and information functions by integrating freeway surveillance, control, and driver information (SC&DI), local traffic signal and transit priority signal systems.

Project Background and Need: The eastside region, including the cities of Bellevue, Kirkland, and Redmond, and east King County are experiencing transportation inefficiencies and congestion resulting from the incompatibility of different jurisdiction's traffic control systems. The transportation system on the eastside, including all major arterials and the state highway system, already experience high levels of congestion and with expected continued population and employment growth, these levels of congestion will continue to increase. A large part of the congestion occurs as travelers move from one jurisdiction's signal system to another. Typically, these signal systems do not communicate or coordinate with one another, even adjacent systems on the same arterial. This lack of communication and coordination between each jurisdiction's signal systems result in an inefficient system for all travelers within the region, including transit and freight.

Statement of Deficiency: Eastside transportation inefficiencies and congestion are resulting from the incompatibility of different jurisdiction's traffic control systems.

Project Description: This ATMS project will provide a system that allows for the integration of traffic signal control systems to permit the optimization of signal systems and integration of ramp control and signal systems between multiple jurisdictions and between technologies. This system will tie into and expand a similar system currently under development in north Seattle. In addition, the ATMS will be capable of both importing and exporting traveler information data to support regional traffic related information systems.

Any improvements will be limited to upgrading controllers where necessary and installing communication lines to signal control systems that do not already have established communication. The East King County ATMS will be connected to the existing WSDOT Northwest Region's TSMC which will contain hardware and software capable of monitoring traffic conditions within east King County, responding to events that degrade the system efficiency, and disseminating traveler information. This will require the upgrading of existing traffic control systems involving activities such as installing vehicle detectors, signal controllers and field communications. The new signal control systems will be monitored and controlled from the TSMC. Transit systems and traffic signal pre-emption will also be incorporated into the ATMS as applicable.

The monitoring and control of the WSDOT SC&DI system will integrate the operations of the ATMS. This integration will involve the implementation of interface hardware and software.

Future expansion can consider the exchange of data with private fleet management operations which will provide data such as travel time that will assist the ATMS in monitoring traffic conditions in east King County.

The design effort will be refined based on the work currently underway to develop and deploy an ATMS in the north Seattle area. Subject to its successful implementation, the east King County ATMS would follow the experience of this effort.

System Capabilities: The proposed ATMS will have the following capabilities:

- Monitor real time traffic conditions along I-405, I-90, SR 520 and other state routes through the eastside SC&DI system;
- Control east King County major arterial traffic control signals (phase sequence and timing) based on a time of day/day of week criteria or in response to planned events or unexpected traffic conditions;

- Control the Eastside VMS to display either pre-designed messages or other messages in response to regional traffic conditions;
- Coordinate with traveler information systems for the Eastside;
- Coordinate operations with local police for regional traffic management.

Project Scope: The project will be divided into two phases: the planning and design phase and the deployment phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of East King County ATMS

The planning and design effort will consist of the following activities:

1. Review North Seattle ATMS evaluation report and the eastside SC&DI program.

2. Design the interconnection and upgrade of east King County's traffic control signal system.

3. Design a control center which will receive field information, disseminate information and control field equipment.

4. Design the communication system to interconnect the field equipment to the control center.

5. Plan for future upgrade and expansion of the system to include the following:

    - interface to private fleet management operations;
    - interface with the state-wide ATIS system to provide traveler information including weather information and traffic conditions.

Phase 2: Implementation and Evaluation of East King County ATMS

The second phase of this project is the implementation and evaluation of the East King County ATMS. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Developing/customizing the software for field equipment and head-end configuration;

5. Testing and evaluating the system; and

6. Evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the preliminary cost estimate. The estimate is based on the proposed Eastside Advanced Traffic Management System (Puget Sound Regional Council, Stage 2 Regional Project TIP Evaluation Form, 1995). A more detailed analysis based on the North Seattle ATMS will be required when formally evaluating this project.

The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$1,500,000
Annual O & M	$150,000

Project Benefits: The project will provide communication and planning between the incompatible signal control systems operated by each of the jurisdictions and the freeway control system operated by WSDOT. Removing the communication and coordination constraints at jurisdictional boundaries will improve the efficiency of freight and people movement and increase system effectiveness within the project area. It will also collect and distribute real-time traffic data and use priority and pre-emptive systems for transit. This information will be made available to travelers to enable them to make real-time decisions about mode choice, departure time, and route.

The project benefits are expected to derive from a reduction in traveler delay caused by congestion and incidents. The Statewide IVHS Plan identifies potential benefits in the Central Puget Sound area as approximately $36,100,000 for ATMS. The East King County region represents roughly 15 percent of the annual vehicle-miles traveled in the Central Puget Sound area which yields:

Annual Benefits	$5,415,000

Project B/C Ratio: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The

discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform Annual Costs	$260,400
Annual Benefits	$5,415,000
Benefit/Cost Ratio	20.8:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the SC&DI system will follow in both the medium-term and long-term time frames.

The planning and design phase (phase 1) of the project would be completed one (1) year after award. The implementation phase (phase 2) would be completed three (3) years after award.

Item	Unit Cost (1995 $)	Units	Total Cost (1995 $)
Planning and Design	1,125,500	1	1,125,500
Construction	375,000	1	375,000
Total Capital Cost			1,500,000
O & M Cost / Year			150,000

Table 1: Cost Summary

Project Title: Develop South King County ATMS

User Services:

Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Travel Demand Management:
- Pre-Trip Travel Information

Public Transportation Operations:
- Public Transportation Management

Commercial Vehicle Operations
- Commercial Fleet Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near-Term to Medium-Term

Objective: To design and implement an Advanced Traffic Management System (ATMS) for the urban areas of South King County. The ATMS will provide cross-jurisdictional highway traffic monitoring, control and information functions by integrating freeway surveillance, control, and driver information (SC&DI), local traffic signal and transit priority signal systems.

Project Background and Need: The southside, including the cities of Tukwila, SeaTac, Des Moines, Federal Way, Renton, Kent, and Auburn, and south King County are experiencing transportation inefficiencies and congestion resulting from the incompatibility of different jurisdiction's traffic control systems. The transportation system on the southside, including all major arterials and the state highway system, already experience high levels of congestion and with expected continued population and employment growth, these levels of congestion will continue to increase. A large part of the congestion occurs as travelers move from one jurisdiction's signal system to another. Typically, these signal systems do not communicate or coordinate with one another, even adjacent systems on the same arterial. This lack of communication and coordination between each jurisdiction's signal systems result in an inefficient system for all travelers within the region, including transit and freight.

Statement of Deficiency: Southside transportation inefficiencies and congestion are resulting from the incompatibility of different jurisdiction's traffic control systems.

Project Description: This ATMS project will provide a system that allows for the integration of traffic signal control systems to permit the optimization of signal systems and integration of ramp control and signal systems between multiple jurisdictions and between technologies. This system will tie into and expand a similar system currently under development in north Seattle. In addition, the ATMS will be capable of both importing and exporting traveler information data to support regional traffic related information systems.

Any improvements will be limited to upgrading controllers where necessary and installing communication lines to signal control systems that do not already have established communication. The South King County ATMS will be connected to the existing WSDOT Northwest Region's TSMC which will contain hardware and software capable of monitoring traffic conditions within south King County, responding to events that degrade the system efficiency, and disseminating traveler information. This will require the upgrading of existing traffic control systems involving activities such as installing vehicle detectors, signal controllers and field communications. The new signal control systems will be monitored and controlled from the TSMC. Transit systems and traffic signal pre-emption will also be incorporated into the ATMS as applicable.

The monitoring and control of the WSDOT SC&DI system will integrate the operations of the ATMS. This integration will involve the implementation of interface hardware and software.

Future expansion can consider the exchange of data with private fleet management operations which will provide data such as travel time that will assist the ATMS in monitoring traffic conditions in south King County.

The design effort will be refined based on the work currently underway to develop and deploy an ATMS in the north Seattle area. Subject to its successful implementation, the south King County ATMS would follow the experience of this effort.

System Capabilities: The proposed ATMS will have the following capabilities:

- Monitor real time traffic conditions along I-405, I-90, SR 520 and other state routes through the southside SC&DI system;
- Control south King County major arterial traffic control signals (phase sequence and timing) based on a time of day/day of week criteria or in response to planned events or unexpected traffic conditions;

- Control the Southside VMS to display either pre-designed messages or other messages in response to regional traffic conditions;
- Coordinate with traveler information systems for the Southside;
- Coordinate operations with local police for regional traffic management.

Project Scope: The project will be divided into two phases: the planning and design phase and the deployment phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of South King County ATMS

The planning and design effort will consist of the following activities:

1. Review North Seattle ATMS evaluation report and the southside SC&DI program.

2. Design the interconnection and upgrade of south King County's traffic control signal system.

3. Design a control center which will receive field information, disseminate information and control field equipment.

4. Design the communication system to interconnect the field equipment to the control center.

5. Plan for future upgrade and expansion of the system to include the following:

    - interface to private fleet management operations;
    - interface with the state-wide ATIS system to provide traveler information including weather information and traffic conditions.

Phase 2: Implementation and Evaluation of South King County ATMS

The second phase of this project is the implementation and evaluation of the South King County ATMS. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Developing/customizing the software for field equipment and head-end configuration;

5. Testing and evaluating the system; and

6. Evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the preliminary cost estimate. The estimate is based on the proposed Eastside Advanced Traffic Management System (Puget Sound Regional Council, Stage 2 Regional Project TIP Evaluation Form, 1995). A more detailed analysis based on the North Seattle ATMS will be required when formally evaluating this project.

The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$5,559,000
Annual O & M	$555,900

Project Benefits: The project will provide communication and planning between the incompatible signal control systems operated by each of the jurisdictions and the freeway control system operated by WSDOT. Removing the communication and coordination constraints at jurisdictional boundaries will improve the efficiency of freight and people movement and increase system effectiveness within the project area. It will also collect and distribute real-time traffic data and use priority and pre-emptive systems for transit. This information will be made available to travelers to enable them to make real-time decisions about mode choice, departure time, and route.

The project benefits are expected to derive from a reduction in traveler delay caused by congestion and incidents. The Statewide IVHS Plan identifies potential benefits in the Central Puget Sound area as approximately $36,100,000 for ATMS. The South King County region represents roughly 15 percent of the annual vehicle-miles traveled in the Central Puget Sound area which yields:

Annual Benefits	$5,415,000

Project B/C Ratio: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The

discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform Annual Costs	$965,042
Annual Benefits	$5,415,000
Benefit/Cost Ratio	5.6:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the SC&DI system will follow in both the medium-term and long-term time frames.

The planning and design phase (phase 1) of the project would be completed one (1) year after award. The implementation phase (phase 2) would be completed three (3) years after award.

Item	Unit Cost (1995 $)	Units	Total Cost (1995 $)
South King County Signal System Upgrade	2,230,000	1	2,230,000
Signal Interconnect	312,500	1	312,500
Control Center	2,000,000	1	2,000,000
Communication System	90,000	1	90,000
Total Construction Cost			4,632,500
Design/Evaluation Cost			926,500
Total Capital Cost			5,559,000
O & M Cost / Year			555,900

Table 1: Cost Summary

Project Title: Develop Pierce County ATMS

User Services:

Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Travel Demand Management:
- Pre-Trip Travel Information

Public Transportation Operations:
- Public Transportation Management

Commercial Vehicle Operations
- Commercial Fleet Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near-Term to Medium-Term

Objective: To design and implement an Advanced Traffic Management System (ATMS) for the urban areas of Pierce County. The ATMS will provide cross-jurisdictional highway traffic monitoring, control and information functions by integrating freeway surveillance, control, and driver information (SC&DI), local traffic signal and transit priority signal systems.

Project Background and Need: Interstate 5 serves as the primary highway connection between Seattle and Portland and is part of the major interstate route which runs from Canada to Mexico along the west coast of the United States. In Pierce County, I-5 is also heavily used by commuters traveling between Seattle and Tacoma. At present, these volumes lead to daily volume to capacity ratios that exceed one. Urban arterials are also congested during peak periods matching the travel on the freeway.

The IVHS vision for Central Puget Sound includes the goal of providing safe and efficient movement of people and commercial vehicles through the transportation system. This requires a coordinated effort to improve the efficiency of each element of the transportation network in Pierce County. For example, the proposed deployment of a surveillance, control, and driver information (SC&DI) system in the Tacoma area along I-5 may benefit from traffic conditions derived from the adjacent arterial roadways. In order to achieve this, a centralized signal control system may be implemented which will collect arterial traffic information for the purpose of sharing the information with regional traveler information

system and the SC&DI. This signal control system will also offer arterial signal coordination as well as coordination with SC&DI operations.

Statement of Deficiency:

Pierce County area traffic congestion is increasing giving rise to greater traveler delay and greater risk of traffic incidents. The congestion is commonly experienced due to volumes exceeding the capacity at intersections within an arterial signal control system, along freeways passing through urban areas and at the boundaries between independent systems. The lack of central control for the signals within the county and lack of capability to coordinate existing systems with proposed systems will contribute to congestion problems as traffic volumes grow.

Project Description:

The project will include planning, designing, implementing, and evaluating an Advanced Traffic Management System (ATMS) for Pierce County. The ATMS will integrate the existing and proposed traffic management systems in Pierce County. In addition, interfaces with the regional traveler information system as well as other data sources will be made available. These include transit vehicle locations and travel times for example.

The major developments will include the design of a central control center which will contain hardware and software capable of monitoring traffic conditions within Pierce County, responding to events that degrade the system efficiency and disseminating traveler information. This will require the upgrading of existing traffic control systems involving activities such as the installation vehicle detectors, signal controllers and field communications. The new signal control systems will be monitored and controlled from the control center. Transit systems and traffic signal pre-emption will also be incorporated into the ATMS as applicable.

The monitoring and control of the I-5 SC&DI system will be integrated the operations of the ATMS. This integration will involve the implementation of interface hardware and software.

Future expansion can consider the exchange of data with private fleet management operations which will provide data such as travel time that will assist the ATMS in monitoring traffic conditions in Pierce County.

The design effort will be refined based on the work currently underway to develop and deploy an ATMS in the North Seattle area. Subject to its successful implementation, the Pierce County ATMS would follow the experience of this effort.

System Capabilities: The proposed ATMS will have the following capabilities:

- Monitor real time traffic conditions along I-5 and other state routes through Tacoma SC&DI;
- Control Pierce County area traffic control signals (phase sequence and timing) based on a time of day/day of week criteria or in response to planned events or unexpected traffic conditions;
- Control the Pierce County area VMS to display either pre-designed messages or other messages in response to regional traffic conditions;
- Coordinate with traveler information systems for the I-5 in this region;
- Coordinate operations with other WSDOT TSMC's local and police for regional traffic management.

Project Scope: The project will be divided into two phases: the planning and design phase and the deployment phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of Pierce County ATMS

The planning and design effort will consist of the following activities:

1. Review North Seattle ATMS evaluation report and the Tacoma area SC&DI program.

2. Design the interconnection and upgrade of the Pierce County traffic control signal system.

3. Design control center which will receive field information, disseminate information and control field equipment.

4. Design the communication system to interconnect the field equipment to the control center.

5. Plan for future upgrade and expansion of the system to include the following:

    - interface to private fleet management operations;
    - interface with the state-wide ATIS system to provide traveler information including weather information and traffic conditions.

Phase 2: Implementation and Evaluation of Pierce County ATMS

The second phase of this project is the implementation and evaluation of the Pierce County ATMS. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Developing/customizing the software for field equipment and head-end configuration;

5. Testing and evaluating the system; and

6. Evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the preliminary. The estimate is based on the current estimate for the North Seattle ATMS of roughly $4 million. The Pierce County infrastructure covers an entire county, but less dense than the North Seattle infrastructure. In addition, this project will benefit from the experience of the North Seattle ATMS. The preliminary estimate of capital costs for the Pierce County ATMS presented in Table 1 considered these factors. A more detailed analysis based on the North Seattle ATMS will be required when formally evaluating this project.

The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$5,559,000
Annual O & M	$555,900

Project Benefits: The project benefits are expected to derive from a reduction in traveler delay caused by congestion and incidents. The Statewide IVHS Plan identifies potential benefits in the Central Puget Sound area as approximately $36,100,000 for ATMS. Assuming that Pierce County represents roughly 19% of the annual vehicle-miles traveled in the Central Puget Sound area which yields:

Annual Benefits	$6,859,000

Project B/C Ratio: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform Annual Costs	$965,042
Annual Benefits	$6,900,608
Benefit/Cost Ratio	7.1:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the SC&DI system will follow in both the medium-term and long-term time frames.

The planning and design phase (phase 1) of the project would be completed one (1) year after award. The implementation phase (phase 2) would be completed three (3) years after award.

Item	Unit Cost (1995 $)	Units	Total Cost (1995 $)
Pierce County Signal System Upgrade	2,230,000	1	2,230,000
Signal Interconnect	312,500	1	312,500
Control Center	2,000,000	1	2,000,000
Communication System	90,000	1	90,000
Total Construction Cost			4,632,500
Design/Evaluation Cost			926,500
Total Capital Cost			5,559,000
O & M Cost / Year			555,900

Table 1: Cost Summary

Project Title: Demonstration of a Work Zone SC&DI System

User Services: Traffic Management:
- Incident Management
- Traffic Control
- Construction Management

Traveler Information:
- En-Route Driver Information

Time Frame: Near Term

Objective: The objective of the project is to demonstrate a portable Surveillance, Control and Driver Information (SC&DI) System that can be applied to work zone management. This system will be designed to be quickly deployable to respond to work zone boundary changes, to be durable to withstand repeated deployment in work zone conditions and to be capable of interfacing with local and regional SC&DI systems. This demonstration will aim to determine the cost effectiveness of such an application in terms of capital cost, maintenance cost, durability, adaptability and ease of deployment.

Project Background and Need: Construction and maintenance work zones on freeways are inherently dangerous for both the field staff and drivers passing through the work area. The work area reduces the road capacity which requires a reduction in speed to safely negotiate the area. This speed differential and the reduced capacity cause traffic congestion which represents both a safety concern and a source of delay for travelers.

Several Advanced Traffic Management Systems (ATMS), currently in operation world wide have demonstrated that similar systems can improve safety and reduce delay. Examples of successful systems in Washington include FAME and Seattle SC&DI system. These systems achieve their benefits by providing central surveillance and control functionality through a network of variable message signs, highway advisory radio, ramp metering subsystems, lane access control subsystems, and emergency vehicle management subsystems.

This success has lead to the desire to perform these SC&DI system functions for the purpose of work zone management independent of currently operating SC&DI systems. The work zone presents similar safety and congestion problems for which these systems are designed to respond. Furthermore, the agency performing the work will anticipate these problems and will be in a position to manage them. In this way,

dynamic work zone management will be available in the immediate work area.

Statement of Deficiency:

Work zones on relatively high volume roads cause traffic disruptions that impact both travel time and safety in the immediate area. Traveler information and traffic management in work zones is currently limited to newspaper announcements, radio announcements, temporary signs and field staff. These methods do not provide traffic monitoring or dynamic traveler information dissemination. By not providing these functions, travelers are experiencing avoidable delay and are unaware of alternative routes to avoid the delay.

Project Description:

The project will demonstrate a work zone SC&DI system capable of monitoring the volumes and speeds of traffic in a work zone while providing lane control, and traveler information dissemination through the use of variable message signs and highway advisory radio. This portable system will be self-contained in terms of power and communications but will be capable of interfacing with regional SC&DI systems for the purpose of coordination and information sharing.

The architecture of the portable SC&DI system consists of four subsystems: traffic monitoring, communications and control, control center and information. The control center subsystem compiles traffic data collected by the traffic monitoring subsystem and provides control of the information and control field devices. The communications subsystem provides the data connections between the other subsystems as well as external entities including other SC&DI systems and emergency services.

The traffic monitoring subsystem will consist of several traffic detector stations each capable of monitoring traffic in up to four lanes individually. In the interest of being portable, the traffic detector stations will consist of a non-intrusive vehicle detection technology. For example, a pole-mounted CCTV camera with pan-tilt-zoom capability, mounted on a stabilized trailer, located at the side of the road. Each of the traffic detection stations will be equipped with remote processing units (RPUs). The RPUs will interpret the data collected, calculates the traffic volume and speed for each lane and stores this data until the control center subsystem polls the RPUs. The RPUs will also have the functionality to control traveler information and control field devices as described below.

The communications subsystem provides the following:

- a data link between the traffic monitoring subsystem and the control center subsystem;
- a data and voice link between the control center subsystem and the traveler information subsystem; and
- a data and voice link between the control center and the local and regional SC&DI systems.

The first link provides for the means for collecting field data and controlling the traffic monitoring devices, if necessary. The second link facilitates the control of the information and control field devices including VMS, lane control signs, field personnel and HAR. The final link allows the portable work zone SC&DI system to coordinate with the local and regional SC&DI systems. Specifically, this link would be used to transmit data or voice information detailing the existing traffic conditions in the work zone to the other systems. However, contact with emergency services will also be possible in the case of a traffic incident in or near the work area. Consistent with the portability goal, all these communications will be wireless such as cellular phone and spread spectrum radio. All RPUs will be capable of interfacing with the communications system to facilitate the communications to the field devices.

The control center subsystem will be located in a trailer at or near the work zone. This trailer will contain the hardware and software required to control the system as well as work zone SC&DI system staff. The hardware will consist of a central computer and monitors to collect and display the field data to control the field devices (i.e. operate lane control signals and change messages for VMS and HAR) and to communicate data to other SC&DI system control centers. The central control software will assist the control center operators with interpretation of field data, data management and field device control. Cellular phones and radios will also be provided to allow communications with both field staff and staff of other SC&DI system control centers.

The traveler information subsystem will consist of several trailer-mounted VMS, lane control signals and a portable HAR transmitter. The VMS will be located upstream of the work zone to display lane closure messages, messages indicating either the prevailing speed or the suggested speed and messages indicating estimated delay and possible diversion routes. A set of lane control signals will be located immediately upstream of the work zone to indicate which lanes are open

and which lane are closed. These signals will collocated with the first VMS immediately upstream of the work zone. Finally, the HAR transmitter is located to provide coverage at the possible diversion point. The HAR will transmit warning messages providing details of the work zone conditions including lane closures and the estimated delay. In addition, messages will be transmitted providing alternate route navigation information. RPUs will be located with each of theses devices to facilitate communications between them and the central control center.

System Capabilities: The proposed project will have the following capabilities:

- Determine the speed differential between traffic in the work zone and traffic approaching the work zone.

- Estimate delay from speed and volume data collected from traffic approaching the work zone.

- Provide details of lane closures, estimated delay, prevailing (or desired) speed, speed differential and suggested alternate routes through a network of VMS, lane control signals and an HAR transmitter.

Project Scope: The project scope will involve two phases. The first phase will develop the Work Zone SC&DI System. The second phase will implement and evaluate the effectiveness of the system at a field test site. The following is a brief description of the tasks of each phase.

Phase 1: Develop Work Zone SC&DI System

The first phase will consist of the following tasks:

1. Developing operations plan.

2. Designing control center software.

3. Designing wireless communications system.

4. Designing field equipment including display technology, mounting and power.

Phase 2: Implementation and Evaluation of Work Zone SC&DI System

Phase 2 will implement and evaluate the Work Zone SC&DI System as developed in the previous phase. The following tasks are included in this phase:

1. Selecting equipment that meets the specifications of the design.

2. Purchasing and assembling all hardware.

3. Developing control center software.

4. Developing communications software.

5. Initial testing of the system.

6. Evaluating performance of the system in a field test.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Work Zone SC&DI System demonstration. The estimate is for the base system which was described above and does not include the planned expansions and upgrades. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10% of the capital cost.

Total Capital Cost	$730,800
Annual O & M	$73,080

Project Benefits: As the Work Zone SC&DI System will provide traffic and incident management, the project benefits are expected to derive from a reduction in delay experienced by travelers due to congestion and incidents related to work zone activity.

To determine the annual benefits of this project, it is assumed that a five mile long application is located on I-5 within the Central Puget Sound region for one year. The Statewide IVHS Plan identifies the Traveler Information benefits as $29,000,000 and the Incident Management benefits as $63,600,000. King County interstate freeways represent 30% of the annual vehicle-miles traveled within the Central Puget Sound area. A five mile stretch represents roughly 4% of the interstate freeway in King County. The annual benefits resulting from this project are estimated as:

Annual Benefits	$1,111,200

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform Annual Costs	$126,867
Annual Benefits	$1,111,200
Benefit/Cost Ratio	8.8:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). The design phase (phase 1) of the project will be completed in twelve (12) months after award. The implementation and evaluation phase will be completed twenty-four (24) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Control System	176,000	1	176,000
Variable Message Sign	30,000	3	90,000
Lane Control Signal Set	36,000	2	60,000
Roadside Data Stations	26,000	3	78,000
HAR System	31,000	1	31,000
RPU Hardware and Software	18,000	9	162,000
Total Construction Cost	-	-	609,000
Design/Evaluation Cost	-	-	121,800
Total Capital Cost	-	-	730,800
O & M Cost/Year	-	-	73,080

Table 1: Cost Summary

Project Title: Develop Regional Multimodal Traveler Information Center

User Services: Traveler Information
- En-Route Driver Information
- Traveler Services Information
- Route Guidance

Travel Demand Management:
- Pre-Trip Travel Information
- Ride Matching and Reservation
- Demand Management and Operations

Public Transportation Management
- En-Route Transit Information
- Public Transportation Management
- Personalized Public Transit

Time Frame: Near-Term

Objective: The objective of the project is to develop a Regional Multimodal Traveler Information Center (RMTIC). The RMTIC will compile regional roadway and transit performance data from existing and planned sources of data. The RMTIC will serve to process the data (i.e. perform data fusion), packaging the data into various formats for subsequent dissemination. The RMTIC will be capable of distributing the processed data to its customers using various communications modes including: voice or computer services, radio broadcasts and kiosks.

Project Background: A variety of ITS initiatives along the Seattle to Portland corridor are either underway or will be developed in the near future. These initiative will generate a wide range of data suitable to provide for ITS user services such as pre-trip and en-route traveler information. Collectively, the information can assist travelers within the region with mode, route and time-of-travel choices.

In order to bridge the gap between the varied and widespread data sources and the travelers, a system architecture connecting all ITS initiatives including a communications backbone will also be developed. This will allow for information travel between the customers and the information providers. A regional traveler information center is a key element to this process as it will become the central processing center by which the regional multimodal data will compiled, processed and formatted for dissemination to the customers. Potential customers include individuals, business travelers, private sector firms, value-added

resellers and public transportation agencies. These entities will also be essential as information providers developing a two-way data exchange.

The system architecture interface standards will be developed under a separate initiative. The Puget Sound regional system architecture deployment will be carried out through the WSDOT regional traveler information project.

Statement of Deficiency:

Currently, there are several independent sources of data within the Puget Sound Region that both collect and disseminate data for their own purposes. Several ITS initiatives will increase the number of sources of data available in the network. Although the information is available it is collected and stored in several locations in different formats. A mechanism for interfacing and integrating the data available from these systems and ITS initiatives is required in order to provide more effective and comprehensive traveler information for all modes of travel in the Puget Sound Region.

Project Description: The project will include three main activities:

1. Designing and deploying the Regional Multimodal Traveler Information Center. The RMTIC will interface the WSDOT SC&DI system, public ATIS systems (i.e. from WSDOT TSMC), private sector ATIS systems (i.e. Metro Traffic), transit agencies in the region (i.e. Riderlink), Employer Based Multimodal Traveler Information System, and provide for interface capabilities for other systems in the Region including Port ATMS, Public Transportation Systems, CVO Application Systems, Regional and Local ATMS, Weather Information Systems, Emergency Notification Systems and Transportation Pricing Systems.

   Most of the interface communication requirements will be provided under different projects, however, the RMTIC will provide for any additional communication hardware required for establishing the interfaces. The RMTIC will provide space for the hardware supporting the interface and data fusion requirements. The RMTIC will also provide space and human interface capabilities to support a systems manager who will maintain the software operation.

2. Establishing policies regarding information access and use. The policies will restrict access to certain information and prevent use for commercial purposes. The policies will also define the level of information that will be managed by the public sector and that

managed by the private sector. The policies will be coded into the system and automatically implemented during the data exchange process.

3. Upgrading existing systems to provide for standard interface capabilities. This will include systems which have already been installed and operational in the Puget Sound Region and which will interface with the RMTIC. This includes such systems as the North Seattle ATMS, the WSDOT SC&DI, the regional transit agencies, and the private sector information service (i.e. Metro Traffic).The effort will include the design and development of the interface requirements.

System Capabilities: The capabilities of the RMTIC can be summarized as following:

- Receive and compile roadway and transit system surveillance and detection information from a variety of sources provided by both the public and private sector entities (i.e. information providers);
- Perform data fusion and other data processing to package the data in various formats; and
- Provide information to a variety of distribution channels (i.e. customers).

Project Scope: The scope of work for the project will include the following tasks:

1. Based on ITS architecture interface standards developed under a separate initiative, establish interface requirements for the existing systems in the Puget Sound Region.
2. Establish information access policies and information dissemination responsibilities for each customer and information provider. In addition, determine the format and frequency of data exchange.
3. Establish the RMTIC system requirements developed from the interface requirements and the data exchange policies.
4. Design the hardware configuration including system interfaces, communications, data storage, RMTIC system data processing and data dissemination.

5. Design the software for the RMTIC including system interfaces, communications, data fusion and other data processing.

6. Design and deploy the RMTIC which will house the hardware and software for the interface and data processing. The RMTIC will also provide space for a system manager for operations monitoring and maintenance purposes.

7. Establish a link to the ITS communication backbone.

8. Conduct system integration tests with each of the customers and information providers.

9. Conduct a complete system operational test.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Regional Multimodal Traveler Information Center. This estimate assumes that communications will be carried by the ITS communications backbone as much as possible. For those information providers or customers where a connection to the backbone is unfeasible, other communications (i.e. modem) will be provided. In addition, it is assumed that the RMTIC will be housed in an existing structure requiring major renovations to accommodate the facility. The annual Operations and Maintenance (O&M) cost estimate consists of to full-time equivalent operational staff, one full-time equivalent maintenance staff, communications costs and facility supplies.

Total Capital Cost =	$2,150,000
Operations and Maintenance Cost/Year =	$300,000

Project Benefits: The benefits will derive from the increase in the coverage of comprehensive information exchanged in the region. Travelers will have better access to information covering a greater area. ITS initiatives in the region will also benefit from accurate and timely information that will serve to coordinate between boundaries. The RMTIC will serves as a critical component connecting several systems that each will provide benefit independently. It is assumed that central coordination at the RMTIC represents 10% of the ATIS benefit estimated in the Statewide IVHS Plan. This results in an annual benefit of:

Annual Benefits:	$2,900,000.

Project B/C Ratio The benefit/cost analysis is based on a 20 year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are assumed to be uniform for the 20 year period.

Equivalent Uniform Annual Costs	$458,240
Annual Benefits	$2,900,000
Benefit/Cost Ratio	6.3:1

Project Schedule: The project is proposed is a near-term ITS project (0-6 years time frame). The project will have a design phase and a construction phase. The design phase will include the establishment of the information access policies, the development of system requirements, hardware design, and software design. The construction phase will include the construction of the facility, hardware installation, software installation and systems integration testing. The design phase will be completed fifteen (15) months after award. The construction phase will be completed in twenty-seven (27) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Link to Communication Backbone	50,000	1	50,000
Other Communications	300,000	1	300,000
RMTIC Facility	300,000	1	300,000
Interface and Processing Hardware Design, Procurement and Installation	600,000	1	600,000
Interface and Processing Software	500,000	1	500,000
Existing Systems Interface Upgrade Requirements	400,000	1	400,000
Total Capital Cost	-	-	2,150,000
O & M Cost/Year	-	-	300,000

Table 1: Cost Summary

Project Title: Pilot Intermodal Terminal Information Kiosks

User Services: Traveler Information:
- Traveler Services Information
- En-Route Driver Information

Travel Demand Management:
- Pre-Trip Travel Information
- Ride Matching and Reservation
- Demand Management and Operations

Public Transportation Management:
- En-Route Transit Information
- Public Transportation Management
- Personalized Public Transit

Time Frame: Near Term

Objective: The objective of the project is to deploy traveler information kiosks at major rail stations along the corridor which function as intermodal transfer points. These kiosks will provide schedule information, connection information to other travel modes (i.e. train schedules and transit schedule), schedule variations and local services information (i.e. accommodations, restaurants and tourist attractions).

Project Background and Need: There are several operational tests and Traveler Information System (TIS) implementations across the U.S. that employ or intend to employ kiosks to provide multimodal traveler information. For example, Los Angeles Smart Traveler will be implementing kiosks using audiotex and videotex to provide transit, paratransit and rideshare information. Within Washington State, the Seattle Smart Traveler program executed an operational test providing transit and ride sharing information to commuters from a single kiosk in Bellevue.

Recently, there have been two local public information efforts that will impact this project. First, the Washington State Department of Information Services implemented a pilot project providing public information through kiosks. This project, Washington Information Network (WIN), was established to help the state government serve the people of Washington State better, faster and more cost-effectively. These kiosks provide a public interface to several government databases including transportation and recreation. The impact this effort will have on this project is the local experience gained through its design and implementation; several issues including data security, communications

protocol as well as public experience with the kiosks have already been addressed.

Second, WSDOT presently maintains several home pages on the world wide web. They provide information such as real-time traffic congestion information for the greater Seattle area freeways and transit access information for the greater Seattle area. These home pages represent excellent sources of traveler information that have established formats and communications protocol (i.e. TCP/IP) which can be accessed as part of this project.

The I-5 Corridor offers a suitable opportunity to implement similar applications. Along the corridor, six major rail stations provide alternate access to regional travelers between Portland and Seattle. In the future, several commuter rail stations will also be suitable candidates for informational kiosks. Both types of rail stations offer an alternative travel mode requiring travelers to change modes. In addition, information on local services such as accommodations, restaurants and tourist attractions will also be useful. Both rail travelers and freeway travelers are expected to benefit from the kiosk network as travel by rail will become more attractive reducing freeway trips and travel times.

Statement of Deficiency:

Public access to intermodal information and information about local services is limited at intermodal transfer centers. Limited access to information hinders the smooth transition of travelers from one mode to another which increases their travel time and discourages them from using travel modes other than personal vehicles.

Project Description:

The project will develop and deploy a fully operational kiosk network at major intermodal transfer centers (i.e. Amtrak rail stations) along the corridor. The project will involve the development of a customized user interface and format suitable for the static and dynamic information that will be made available as well as the implementation of the kiosk network.

Existing data useful to intermodal travelers will be identified and access to this data will be arranged. This data includes the posted schedules of various modes that serve the intermodal center including rail and transit. In addition to these schedules, route and travel time information will be made available to assist in traveler route and mode selection. The kiosks will also provide instructions detailing access to taxi and shuttle services from the intermodal center. Finally, information detailing local

services, such as restaurants, accommodations and special events, will also be made available at the kiosks.

Dynamic data will also be made available to the kiosks. These include schedule variations for both ferries and trains, corridor traffic and road conditions, weather conditions as they affect travel and traveler advisories. Access to other agencies and services that collect this dynamic data will provide this information. Local special events will also be provided to the kiosks as dynamic data.

All data and information will be collected centrally at a WSDOT office. This data will be managed in several databases at that location automating the process for all but local service announcements. From this central location, the kiosks will be updated by modem periodically.

System Capabilities: The proposed project will have the following capabilities:

- Provide a personal and accessible interface by which travelers can request information using a touch screen, a pointing device and a keyboard and view this information using a color monitor, clear sound-generating equipment and a printer;

- Provide static and dynamic traveler information including rail and transit schedules, schedule compliance, connections to taxi and shuttles, and weather information along the corridor;

- Provide local service information including restaurants, accommodations and special events; and

- Provide a gateway to current and future home page information that convey dynamic traveler information.

Project Scope: The project scope will involve two phases. The first phase will develop the kiosk interface, screen format, central database and communications. The second phase will implement and evaluate the effectiveness of the kiosk network. The following is a brief description of the tasks of each phase.

Phase 1: Develop and Deploy Interface and Format

The first phase will consist of the following tasks:

1. Confirming availability of data from Amtrak, transit services, weather service and local services.

2. Identifying local service displays that will be available on the kiosks. Definition of cost-sharing arrangement for these local services.

3. Arranging for access to both static and dynamic data including communications network and protocol.

4. Coordinating with the Washington Information Network (WIN) design to facilitate possible coordination or possible fusion of both networks.

5. Completing of interface design defining kiosk construction, database format, screen output format and printer output format.

6. Completing design of the central control for the kiosk network including communications, database format, and automation of data queries and updates.

Phase 2: Implementation and Evaluation of Kiosk Network

Phase 2 will implement and evaluate the kiosks as developed in the previous phase. The following tasks are included in this phase:

1. Selecting equipment that meets the specifications of the design.

2. Purchasing, constructing and installing the central computer, communications hardware and kiosks.

3. Developing and customizing the software.

4. Testing and evaluating the kiosk network.

5. Evaluation of performance and use of the kiosk network.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Intermodal Terminal Information Kiosk Network. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at

10% of the capital cost. Communications to transmit information updates from the WSDOT office to the remote kiosks is provided by the existing communications infrastructure (i.e. SCAN).

Total Capital Cost	$475,200
Annual O&M	$47,520

Project Benefits: The project benefits are expected to derive from intermodal travel time savings as their transfer will be assisted by the kiosk information. In addition, it is anticipated that local service providers and other commercial interests will provide advertising revenue.

The Statewide IVHS Plan identifies annual benefits due to traveler information systems as $7,457,255 in Vancouver, $29,151,690 in Central Puget Sound and $17,880 in other urban areas. Assuming that 1% of this benefit is due to kiosk operation at terminals, the sum of these benefits is $366,268. The annual advertising revenue expected per kiosk is $5,000 totaling to $35,000.

Annual Benefits	$401,268

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance cost are assumed to be uniform over the 20 year period.

Equivalent Uniform Annual Costs	$82,495
Annual Benefits	$401,268
Benefit/Cost Ratio	4.9:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). Follow-up projects to expand and upgrade the Intermodal Terminal Information Kiosk Network will follow in both the near-term time frame and the medium-term time frame.

The planning and design phase of the project will be completed in six (6) months after award. The implementation and evaluation phase will be completed in eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Central Control Hardware and Software	200,000	1	200,000
Kiosk Hardware and Software (including CPU, keyboard, pointing device, touch screen color monitor, multi-media capability, modem and printer)	25,000	7	175,000
Kiosk Cabinet	3,000	7	21,000
Total Construction Cost	-	-	396,000
Design/Evaluation Cost	-	-	79,200
Total Capital Cost	-	-	475,200
O & M Cost/Year	-	-	47,520

Table 1: Cost Summary

Project Title: Demonstrate Employer Based Multimodal Traveler Information System

User Services:
Traveler Information
- Traveler Services Information

Travel Demand Management:
- Pre-Trip Travel Information
- Ride Matching and Reservation

Public Transportation Management
- Personalized Public Transit

Electronic Payment Services
Weather Surveillance

Time Frame: Near-Term

Objective: The objective of the project is to demonstrate the feasibility of providing Employer-Based Multimodal Traveler Information System in the Northwest Region using kiosks that provide personal computer access to a bulletin board or home page.

Project Background and Need: Travel demand management is a component of the ITS user services that focuses on reducing demand and encouraging the use of high occupancy modes of travel. These services including pre-trip planning, ride matching and carpool/vanpool management are suitable methods to attempt to attain the goals of the Commute Trip Reduction Law. In addition, as these services are most useful when provided at the travelers' trip origin, they are suitable for implementation as work-based services maintained by the employers. In fact, the new law requires that the employers participate in providing these services.

The means to provide this information to travelers at the office has been limited to the telephone and the radio. However, the means to significantly improve this service is becoming increasingly available as the use of personal computers with modems at the office becomes more widespread. Currently, several businesses rely on their access to the Internet and other "on-line" information services. This also allows businesses access to recent WSDOT and Metro initiatives that provide a traffic information map and bus route information through a World Wide Web home page on the Internet.

This existing infrastructure, together with a market that promises to continue growing, provides an excellent means to provide a Multimodal Traveler Information System which will be readily accessible to

travelers while at the office. To supplement the personal computer access available, kiosks may be located in building lobbies to provide the same access away from the desk.

Statement of Deficiency:

There is an increasing need in the Puget Sound area to improve air quality through a reduction in traffic congestion. The adoption of the Commute Trip Reduction Law gave employers partial responsibility of attaining these goals through programs to reduce Single Occupancy Vehicle (SOV) trips to and from work. At present, there are few successful models which employers can pattern there own programs. In addition, no infrastructure is available to provide the transfer of real-time information necessary to assist the employer-based trip reduction programs.

Project Description:

The project will involve designing, implementing and evaluating a multimodal traveler information system in an industrialized/commercial park in the Puget Sound Area. The system will be developed in coordination with the employer(s) occupying the park. Potential employers include Microsoft Corporation and the Boeing Company. The follow-up work will involve the wide-spread implementation of the system in the Puget Sound Region.

The system will advise employees at the work site of current transportation conditions and travel options, and help employers achieve Single Occupancy Vehicle (SOV) reduction to comply with the Commute Trip Reduction Law. The system would encompass two major elements:

1. Information kiosks and PC-based software along with interfaces that would provide traffic, transit and other information using the Regional Multimodal Traveler Information Center (RMTIC); and

2. Ride matching and carpool/vanpool management services for use by employer administrative staff to facilitate trip and travel reduction. It is anticipated that this would involve a stand-alone, PC-based application program that would allow static semi-dynamic ride matching to be undertaken at the employment location.

System Capabilities:

The system will encompass the following capabilities:

- Interface with the RMTIC to receive static and real-time information relating to traffic conditions, construction activities, special events,

transit bus schedules and route information, and other information which will be collected and processed by the RMTIC.

- Accept ride-matching requests from employees, process the requests and schedule carpool/vanpool departure times and routes.

- Provide for a human interface to disseminate information from the RMTIC using kiosks and PC computers.

Project Scope: The project scope will involve two phases, with a third phase to be undertaken under a follow-up project. The first phase will involve the deployment of the demonstration system. The second will involve assessing the effectiveness of the system. The third phase, to be conducted under a separate project, will involve the deployment of the system on a larger scale in the Puget Sound Region.

Phase 1: Design and Deployment of the Demonstration System

The following activities will be conducted under this phase:

1. Identify partner employer and develop institutional agreement.

2. Design the system architecture and equipment interface.

3. Design system software.

4. Design kiosk hardware and software.

5. Implement system and interface with RMTIC.

Phase 2: Evaluate the Effectiveness of the Demonstration System

1. Develop measures of effectiveness and collect data to support the evaluation.

2. Conduct the evaluation study and develop recommendations for follow-on deployment work.

Project Cost: Table 1 presents a summary explanation of the capital cost (for the demonstration project) in 1995 dollars for the subject system. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10% of the capital cost.

Total Capital Cost	$216,000
Annual O&M	$21,600

Project Benefits: The expected benefits would be derived from providing a multimodal employer based traveler information system include a reduction in commute travel times, a reduction in Single Vehicle Occupancy (SOV), and reduction in commute trip costs such as vehicle operating cost. The Statewide IVHS Plan identifies the potential benefits in the Central Puget Sound area as approximately $29,000,000 for ATIS. As the benefits depend on the number of people participating, it is estimated that this demonstration will achieve roughly 1% of these benefits; therefore, the annual benefits are estimated as:

Annual Benefits	$290,000

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are assumed to be uniform for the 20-year period.

Equivalent Uniform Annual Cost	$38,080
Annual Benefit	$290,000
Benefit/Cost Ratio	7.6:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). Projects to implement the service on a wider scale in the Puget Sound Region will follow in both the near-term time frame and the medium-term time frame.

Phase 1 of the project will be initiated after the establishment of the Employer Based Multimodal Traveler Information System and will be completed twelve (12) months after award. Phase 2 of the project will commence after the completion of the installation and be completed eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Kiosk	50,000	2	100,000
Interface Requirements	10,000	1	10,000
Computer Hardware	10,000	1	10,000
Computer Software	60,000	1	60,000
Total Construction Cost	-	-	180,000
Design/Evaluation Cost	-	-	36,000
Total Capital Cost	-	-	216,000
O & M Cost/Year	-	-	21,600

Table 1: Cost Summary

Project Title: Demonstrate Port ATMS Concept

User Services: Traffic Management:
Traffic Control
Travel Demand Management:
Demand Management and Operations

Time Frame: Near-Term

Objective: To design and implement an Advanced Traffic Management System (ATMS) for the Port of Tacoma. The ATMS will coordinate the operations of the local traffic signal system, port access VMS and CCTV systems and the I-5 freeway SC&DI in an effort to manage the truck activity accessing the port.

Project Background and Need:

The Port of Tacoma facilities include terminals for handling all commodity types. In 1991, the Port of Tacoma handled 1,016,000 TEUs which accounted for over 7 million tons of containerized cargo. A significant portion of this cargo is moved by truck. Truck access improvements are critical to the Port of Tacoma operations. The truck routes from Interstate 5 to the Port of Tacoma have three options. Portland Avenue for Southbound traffic at exit 133 and for northbound traffic at exit 136. Exit 137 is also used for Hylebos Waterway terminals from either direction. Container traffic accessing Tacoma Terminals often uses Portland Avenue, while Terminals 3, 4 and 7 usually use Port of Tacoma Road.

Several access improvement projects are either underway or being planned. The Port of Tacoma is participating in a major project that will significantly improve vehicular access in the tidal flats area - construction of SR-509. Other projects that are under consideration include the extension of SR 167 from Puyallup at Meridian Street, the capacity expansion of the Port of Tacoma Road which is increasingly congested, and the improvement of Portland Avenue which is currently in poor condition and may limit truck traffic in the future.

In addition to the physical improvements, there is an increasing need to better manage the traffic accessing the Port of Tacoma. The proposed ATMS project will constitute one in a series of projects aimed at building an Intelligent Transportation System for managing truck activities around and within the boundaries of the Port of Tacoma. The ultimate system will be integrated with the I-5 Corridor ITS.

Project Description: The project will include planning, designing, implementing and evaluating an Advanced Traffic Management System for the Port of Tacoma. The ATMS will integrate the existing local traffic signals with planned variable message signs and closed circuit television for the port access area. The existing traffic control signal system will be upgraded and inter-connected. Two (2) variable message signs will be installed on I-5.

The Northbound VMS will be located south of the I-705 interchange, whereas the Southbound VMS will be located north of Exit 137. Four (4) CCTV cameras will be installed at the key truck access routes to the port. A camera will be installed at each of the following intersections to monitor the truck traffic entering the port area: 1) SR 99 and Taylor Way, 2) SR 99 and Port of Tacoma Road, 3) SR 99 and Portland Avenue, and 4) future SR 509 and I-705.

The control units for the signals, VMS and CCTV will be located at a dedicated port operations center. This operations center will also have a two-way communication capability with the (regional) I-5 SC&DI Operations Control Center for coordination of surveillance, control and port access from the I-5, in particular for coordination of VMS messages at locations upstream of the port exits on I-5, and the one VMS at Exit 133 along the I-5 at Portland Avenue.

System Capabilities: The proposed ATMS will have the following capabilities:

- Control the port area traffic control signals (phase sequence and timing) based on a time of day/day of week criteria or in response to planned events (such as special events at Tacoma Dome) or unexpected traffic conditions (such as incidents);

- Control the port access Variable Message Signs (VMS) to display either pre-designed messages or other messages in response to traffic conditions at the port access;

- Monitor real-time traffic conditions along the four major truck access routes into the Port of Tacoma using the CCTV system; and

- Coordinate port truck access information dissemination along the I-5 with the regional SC&DI.

Project Scope: The project will be divided into two phases, the planning and design phase and the implementation phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of Port of Tacoma ATMS

The planning and design effort will consist of the following activities:

1. Design the interconnection and upgrade of the port area traffic control signal system. This effort will include analyzing base and projected traffic conditions in the port area, designing optimal signal phasing and timing plans for various operational scenarios (e.g., time of day/day of week), designing the system interconnect and upgrade into a coordinated system, determining the need for additional traffic control signal at uncontrolled intersections and designing the system controls at the port operations center. The design should allow for future upgrade of the system to accept loop detector data for real-time phase adjustment.

2. Develop a variable message sign system which will initially consist of two variable message signs located along I-5. One Northbound VMS will be located south of the I-705 interchange, and one Southbound VMS will be located north of Exit 137. The design will include developing specifications for the signs and the head-end support system, determining the exact location of the signs, and developing a message library. The signs would be controlled from the operations center. The messages displayed on those VMS will be coordinated with the (regional) I-5 SC&DI Operations Control Center.

3. Design a Closed Circuit Television (CCTV) system, which will include four (4) CCTV cameras to be installed at the key truck access routes to the port. A camera will be installed at the following intersection: SR 99 and Taylor Way, SR 99 and Port of Tacoma Road, SR 99 and Portland Avenue, and future SR 509 and I-705. The design will include developing specifications for the cameras, housing, Pan, Tilt and Zoom (PTZ) unit and display monitors. The design will also include determining the exact location and designing the mounting for each camera unit.

4. Design the communication system to interconnect the field equipment, including the VMS, CCTV cameras, traffic control signals and local controllers, to the port operations center. This effort will also include designing the interface and communication

requirements between the port operations center and the (regional) I-5 SC&DI Operations Control Center.

5. Plan and design the Port of Tacoma Operations Center. This effort includes determining a location for the Center, determining the space and personnel requirements and the layout. The Operations Center could be co-located within an existing Port of Tacoma office. The effort will also include the design of both the hardware and software of the main workstations.

6. Plan for future upgrade and expansion of the system to include the following:

   - addition of VMS at port exit locations;
   - addition of the capability to receive loop detector data for real-time traffic adaptive control signals;
   - addition of a truck queuing system;
   - interface to the state-wide CVO program and a weigh-by-pass station; and
   - interface with the state-wide ATIS system to receive traveler information including weather information.

Phase 2: Implementation and Evaluation of the Port of Tacoma ATMS

The phase 2 of the project is the implementation and evaluation phase of the Port of Tacoma ATMS. This will include the following activities:

1. Selecting equipment that meets the specifications of the design;

2. Purchasing and installing the field equipment;

3. Purchasing and installing the communication hardware;

4. Purchasing and installing the Operation Center's equipment;

5. Developing/customizing the software for field controllers and head-end configuration;

6. Constructing the operations center;

7. Integrating the ATMS;

8. Testing and evaluating the system; and

9. Evaluating the performance of the system in terms of improvements to the port operations.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Port of Tacoma ATMS. The estimate is for the base system which was described above and does not include the planned expansions and upgrades. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10% of the capital cost.

Total Capital Cost =	$1,695,000
Operations and Maintenance Cost/Year =	$169,500

Project Benefits: The project benefits are expected to concentrate on the net reduction in shipment delays as a result of the coordinated traffic control signal system, supported by the VMS and CCTV systems. The benefits are estimated as a function of percent time savings per truck and the shipper's/trucker's value of time. The following is an estimation of the expected benefits quantified in 1995 $US:

Average Port Access Delay Per Truck (minutes) =	10
Number of Trucks Accessing the Port/Year =	1,100,000
Total Port Access Delays/Year (minutes) =	11,000,000
Expected Port Access Time Savings (%) =	10%
Total Time Savings/Year (minutes) =	1,100,000
Value of Time (shippers)/Minute =	$1.25
Total Savings/Year =	$1,375,000

Project B/C Ratio The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The assumed rate of return is 0%; thus, the cost-benefit analysis is based on the average costs of projects during their life spans, disregarding inflation. This is a reasonable assumption, given the decreasing costs of many ITS technologies as their use expands in the marketplace.

Equivalent Uniform Annual Cost	$294,252
Annual Benefit	$1,375,000
Benefit/Cost Ratio	4.7:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). Follow-up projects to expand and upgrade the Port of Tacoma ATMS will follow in both the near-term time frame and the medium-term time frame.

The planning and design phase (phase 1) of the project will be completed in eight (8) months after award. The implementation phase (phase 2) will be completed in eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
System Interconnect and Signal Timing	312,500	1	312,500
Variable Message Signs	170,000	2	340,000
CCTV	45,000	1	180,000
Communications System	30,000	1	30,000
Port Operations Center	530,000	1	530,000
System Expansion	20,000	1	20,000
Total Construction Cost	-	-	1,412,500
Design/Evaluation Cost	-	-	282,500
Total Capital Cost	-	-	1,695,000
O & M Cost/Year	-	-	169,500

Table 1: Cost Summary

Project Title: Demonstrate Rural SC&DI System in Centralia/Chehalis Area

User Services: Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control

Travel Demand Management:
- Pre-Trip Travel Information

Commercial Vehicle Operations:
- Commercial Fleet Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near Term

Objective: The objective of the project is to demonstrate a rural Surveillance, Control and Driver Information (SC&DI) System in the Centralia/Chehalis area. This system will be a "light infrastructure" SC&DI system covering a large geographic area at a relatively low cost. This demonstration will aim to determine the cost effectiveness of a rural SC&DI system in terms of capital and maintenance costs.

Project Background and Need: The Centralia/Chehalis area of the I-5 corridor is roughly fourteen miles long, bordered by interchanges 68 and 82. This section of the freeway consists of a four lane roadway which carries the lowest traffic volumes in the corridor. The current volume to capacity ratios for this area range between 0.5 and 0.6 and the current percentage trucks ranges between 20% and 30%. In addition to being the key inter-city connector in the corridor, the Centralia/Chehalis area of the corridor provides the main access to the mountain and coastal regions for this area via Route 12 and SR 6.

Currently, there are also potential environmental concerns which pose as congestion and safety threats to travel through this area. Specifically, these threats are flooding and fog. The Centralia/Chehalis area has been identified as a potential flooding area. In addition, a relatively high level of fog-related accidents have occurred along the corridor in this area.

The projected 2012 volume to capacity ratio in this area is greater than 0.8, with the volume to capacity ratio at the SR 6 interchange is expected to approach 1.0. In addition, it is expected that a higher percentage trucks will be present in this area. This is due both to an expected growth in truck traffic of 28% over 1990 levels in the Puget

Sound Region and to lower levels of development and lower commuter trips in the inter-city areas.

The increase in the volume to capacity ratios in this area is expected to result in a decrease in the level of service as well as an increase in the accident rate. As there are four travel lanes on the I-5 in the Centralia/Chehalis area, incidents in this area will cause capacity reductions that represent a significant portion of the of the capacity and will severely impact traffic operations as the volume to capacity ratio will jump significantly.

Considering that a significant portion of this traffic is commercial traffic and that alternative routes are limited, this situation represents a societal cost which warrants the implementation of an SC&DI system. However, the volumes in this area are relatively low and the geographic area is relatively large making it difficult to justify a comprehensive SC&DI system. Instead, a "light infrastructure" SC&DI system is suggested to help address the anticipated system deficiencies. The main functions of the SC&DI system will be to detect and keep travelers informed of incidents, major congestion, hazardous environmental conditions in the Centralia/Chehalis area.

Statement of Deficiency:

As urban areas grow along the corridor, the traffic on rural roads between these urban areas will increase presenting sufficient volume-to-capacity ratios to cause congestion and increase the potential for incidents. An incident or hazardous environmental conditions on these rural roads will have a severe impact on traffic operations as small reductions in capacity represent a significant portion of the design capacity, and will likely result in significant congestion. This increased congestion combined with the limited available alternative routes will further complicate travel in this area.

Project Description: The project will demonstrate a rural SC&DI system capable of detecting major delays and hazardous environmental conditions remotely on the I-5 in the rural Centralia/Chehalis area, transmitting this data to the Southwest Regional Traveler Information System, and transmitting congestion and alternative route information to travelers through the area. This will be achieved by vehicle detector stations (DS), variable message signs (VMS), and highway advisory radio (HAR) all configured to communicate through a wireless infrastructure to a central workstation at a WSDOT Regional or Maintenance office.

The traffic monitoring system will consist of several DS with independent controllers monitoring traffic in all lanes. The DS controllers will interpret the data collected and calculate the traffic speeds, volumes and occupancies for each lane.

The environmental conditions monitoring subsystem will consist of several detectors capable of monitoring fog and flood conditions. Remote controllers will determine when fog or flood conditions exist and will communicate this information to the central control.

The communications subsystem provides the following:

- a data link between the traffic monitoring devices (vehicle detectors) and the WSDOT workstation;
- a data link between the WSDOT workstation and the traveler information subsystem (VMS and HAR); and
- a data link between the WSDOT workstation and other TSMC's in Portland/Vancouver, Tacoma, and Seattle.

The first link provides for the means for collecting field data. The second link facilitates the control of the information field devices including VMS and HAR. The final link allows the rural SC&DI system to coordinate with other regional traveler information systems along the corridor. Mainly, this link would be used to transmit congestion and potential incident information as detected in the Centralia/Chehalis area. Due to the remote nature of the system, field device communications will be wireless such as cellular phone and spread spectrum radio. Communications to other TSMC's will be accomplished through the corridor communications network.

The monitoring and control workstation will be integrated into the regional WSDOT office or local maintenance yard. The subsystem will consist of the hardware and software required to control the system. The hardware will consist of computers and monitors to collect and display the information collected in the field, to control the field devices (i.e. change messages for VMS and HAR) and to communicate with other control centers.

The traveler information subsystem will consist of several VMS and HAR transmitters. These devices will be located at periodic intervals along the corridor in the Centralia/Chehalis area. The HAR transmitters will be located to provide coverage for the corridor in the Centralia/Chehalis area. The HAR will transmit warning messages providing general details of the traffic operations for the rural area

including construction advisories, confirmed incidents, fog, flooding and other major delays. In addition, messages will be transmitted providing alternate route navigation information. Drivers will be notified of traffic advisories with fixed signs and flashing beacons as on other WSDOT roads.

System Capabilities: The proposed project will have the following capabilities:

- Detect incidents and congestion;
- Estimate delay from volume, speed and occupancy data collected along I-5 corridor in the Centralia/Chehalis area;
- Detect hazardous fog and flood conditions;
- Provide details of constructions delays, confirmed incidents, major delays, prevailing speeds and possible alternate routes through a network of VMS and HAR transmitters;
- Maintain a database storing construction information, confirmed incident information, and data for planning purposes;
- Monitor database information to determine if any device state changes are required notifying operations staff when necessary (i.e. confirm construction messages are correct or confirm incidents still exists); and
- Provide a system that will support construction and work zone management for potential freeway widening projects.

Project Scope: The project scope will involve two phases. The first phase will develop the Rural SC&DI System. The second phase will implement and evaluate the effectiveness of the system in the Centralia/Chehalis area. The following is a brief description of the tasks of each phase.

<u>Phase 1: Develop Rural SC&DI System</u>
The first phase will consist of the following tasks:

1. Developing operations plan.

2. Designing control center software.

3. Designing wireless communications system.

4. Designing field equipment including detection technology, display technology, mounting and power.

Phase 2: Implementation and Evaluation of Rural SC&DI System

Phase 2 will implement and evaluate the Rural SC&DI System as developed in the previous phase. The following tasks are included in this phase:

1. Selecting equipment that meets the specifications of the design.

2. Purchasing and assembling all hardware.

3. Developing control center software.

4. Developing communications software.

5. Initial testing of the system.

6. Evaluating performance of the system in a field test.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Rural SC&DI System demonstration. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10% of the capital cost.

Total Capital Cost	$2,484,000
Annual O&M	$248,400

Project Benefits: The project benefits are expected to derive from a reduction in delay experienced by travelers due to congestion and incidents. Assuming no road widening improvements takes place in the region, the benefits determined in the Statewide IVHS Plan for other urban areas is applicable.

The Centralia/Chehalis area represents 10% of the freeway for other urban areas covered in the State IVHS Plan. This represents 4025 person-hours of delay of congestion annually. The truck percentage is 24% and it is assumed that 80% of the delay is experienced at peak hour. Considering values of $5.55 for peak vehicles, $2.75 for non-peak vehicles, and $60.00 for trucks, the cost of the delay is approximately $73,225. The functionality of the SC&DI is expected to reduce this cost by 37% yielding an annual benefit of approximately $27,100.

Traffic incidents in this area cost annually $241,128 per mile. Assuming implementation of the SC&DI system reduces incidents by

10% and considering a 20 mile length of the I-5, the benefit received is $482,256.

Totaling these two benefits provides an annual benefit of:

Annual Benefits	$509,356

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are assumed to be uniform over the 20 year period.

Equivalent Uniform Annual Costs	$431,222
Annual Benefits	$509,356
Benefit/Cost Ratio	1.18:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). The design phase of the project will be completed in six (6) months after award. The implementation and evaluation phase will be completed eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Data Stations	50,000	3	400,000
Variable Message Signs	170,000	4	680,000
HAR System	83,000	2	166,000
Fog and Flood Detection	70,000	4	280,000
Communications System and TSMC	419,000	1	419,000
System Expansion	125,000	1	125,000
Total Construction Cost	-	-	2,070,000
Design/Evaluation Cost	-	-	414,000
Total Capital Cost	-	-	2,484,000
O & M Cost/Year	-	-	248,400

Table 1: Cost Summary

Project Title: Deploy US 30 Route Diversion System

User Services: Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Time Frame: Near-Term

Objective: The primary objective of this project is to use ITS technology to inform travelers of an alternate route when I-5 is closed for significant periods of time between Kelso and Vancouver due to a major incident or planned event.

Project Background and Needs: Interstate 5 serves as the primary highway connection between Seattle and Portland and is part of the major interstate route which runs from Canada to Mexico along the west coast of the United States. The 29-mile segment between Kelso and the I-5/I-205 interchange in Vancouver has no nearby state highway which can be used as a detour route in case I-5 is closed to traffic due to some major incident along I-5. The nearest detour is US 30 which parallels I-5 on the Oregon side of the Columbia River. The detour route is approximately 56 miles long, 11 miles longer than the distance between the same two points on I-5. Travel time between the start and end points of the detour is estimated to be approximately 50 minutes along I-5 (a divided multi-lane highway) and approximately 70 minutes along US 30. Any delay which is longer than 20 minutes would make the detour an effective alternative to waiting for I-5 to be cleared.

Between Kelso and Vancouver, I-5 had an Average Annual Daily Traffic (AADT) volume of 46,000 vehicles per day (vpd) in 1993. Trucks made up approximately 19 percent (5,900 vpd) of the 1993 AADT. The 2012 AADT is projected to be approximately 77,000 vpd of which approximately 14,400 vpd would be trucks. This I-5 segment contains three Hazardous Accident Corridors which have an annual societal cost of approximately $2.8 million per year. For the five-year period ending November 30, 1993, there were about 200 accidents per year of which 36 percent of the accidents involved injuries or fatalities along this stretch of I-5. If an injury/fatality accident closes I-5 to through traffic for at least 30 minutes it follows that a detour route should be available for travelers. Since an injury/fatality accident

occurs approximately once every five days, a need currently exists for travelers along I-5 to be alerted to the availability of a detour route.

Statement of Deficiency: A need currently exists for travelers along I-5 to be alerted to the availability of a detour route along US 30 whenever I-5 is closed due to a planned event or unexpected traffic conditions.

Project Description: To design and implement a route diversion system from I-5 to US 30 between Kelso, Washington and Portland, Oregon. This project would advise travelers that I-5 is closed at a certain location and direct through traffic to the detour route.

System Capabilities: The proposed US 30 route diversion system will have the following capabilities:

- Control the route diversion system's Variable Message Signs (VMS) to display either pre-designed messages or other messages in response to planned events (such as construction) or unexpected traffic conditions (such as incidents);
- Disseminate the traffic related event information to the proposed regional traveler information services;
- Operational procedures for when the diversion system should be activated and coordination between the affected state and local agencies, i.e. WSDOT, WSP, ODOT, OSP, and county sheriffs; and
- Links to ODOT and WSDOT control centers .

Project Scope: The project will be divided into two phases, the planning and design phase and the implementation phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of US 30 Route Diversion System

The planning and design effort will consist of the following activities:

1. Develop a variable message sign (VMS) system which will consist of nine variable message signs: two VMS located along I-5 and seven VMS marking the detour route along US 30. Northbound

travelers will be advised to use the detour route by an existing sign located south of the I-405 interchange (Exit 299) in Portland. Four signs will guide travelers along the northbound detour. Southbound travelers will be advised by a sign located north of Exit 37 near Kelso. Three signs will be located at critical locations along the southbound detour route. The design will include developing specifications for the signs and the interface to the Oregon Department of Transportation's Portland Regionwide ATMS Traffic Management Operations Center (TMOC) or WSDOT's regional office, determining the exact location of the signs, and developing a message library. All signs would be controlled from the TMOC.

2. Design the communication system to interconnect the VMS to the TMOC. This effort will also include designing the interface and communication requirements between the TMOC and the proposed regional traveler information system.

3. Develop operational procedures for activation of the route diversion system, informing affected government agencies, and informing the traveling public.

Phase 2: Implementation of the US 30 Route Diversion System

Phase 2 of the project is the implementation phase of the US 30 Route Diversion System. This will include the following activities:

1. Selecting equipment that meets the specifications of the design;

2. Purchasing and installing the field equipment;

3. Purchasing and installing the communication hardware;

4. Purchasing and installing the TMOC's equipment;

5. Developing/customizing the software for field controllers and TMOC configuration;

6. Integrating the Route Diversion System into the TMOC; and

7. Testing and evaluating the system.

Project Cost: Table 1 presents a summary of the capital costs in 1995 dollars for the US 30 Route Diversion System. The estimate is for the base system

which was described above and does not include expansions or upgrades. The design cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 15 percent of the capital cost.

Total Capital Cost =	$552,000
Operating and Maintenance Cost/Year =	$82,800

Project Benefits: The project is expected to benefit private motor carriers, state regulatory agencies, and the general public. The savings are based upon the waiting time and operating costs saved by keeping travelers moving instead of waiting for the I-5 to be opened to traffic. The benefits are only calculated in terms of injury/fatality accidents and do not include road closures due to other types of incidents or planned events. The following is an estimation of the expected benefits quantified in 1995 $US:

Number of Accidents/Year =	200
Accidents Requiring Diversion (%) =	36%
Time Savings by Diversion/Year (hours) =	12
Number of Hours/Day =	24
Number of Passenger Vehicles/Day =	40,100
Average Car Occupancy/Vehicle =	1.35
Number of Passengers/Day =	54,135
SOV Cost Parameter ($ per person/hour) =	$6.30
SOV Cost Savings/Year =	$170,525
Number of Trucks/Day =	5,900
Truck Cost Parameter ($ per truck/hour) =	$21.40
Truck Cost Savings/Year =	$63,130
Annual Benefits	$233,655

Project B/C Ratio: The benefit/cost ratio is based on a 20 year amortization of capital and O&M costs and the reduced costs to motor carriers in operating costs. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS plan.

Equivalent Uniform Annual Cost	$123,427
Annual Benefits	$233,655
Benefit/Cost Ratio	1.9 : 1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). The planning phase (phase 1) of the project would be completed one year after award. The implementation phase (phase 2) would be completed two years after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Variable Message Signs - Mainline	150,000	1	150,000
Variable Message Signs - Detour Route	30,000	7	210,000
Communications System	25,000	1	25,000
Control System at TMOC	25,000	1	25,000
Integration	50,000	1	50,000
Total Construction Cost	-	-	460,000
Design Cost	-	-	92,000
Total Capital Cost	-	-	552,000
O & M Cost/Year	-	-	82,800

Table 1: Cost Summary

Project Title: Pilot Rest Stop Information Kiosks

User Services: Traveler Information:
Traveler Services Information
En-Route Driver Information

Time Frame: Near Term

Objective: The objective of the project is to demonstrate a rest stop information kiosk at a gas station fruit stand along State Route 12 in the I-5 Corridor. This project will be used to assess the operational requirements and feasibility of providing both static and real-time traveler information at remote highway rest stops.

Project Background and Need: There are several operational tests and Traveler Information System (TIS) implementations across the U.S. that employ or intend to employ kiosks to provide multimodal traveler information. For example, Los Angeles Smart Traveler will be implementing kiosks using audiotex and videotex to provide transit, paratransit and rideshare information. Within Washington State, the Seattle Smart Traveler program executed an operational test providing transit and ride sharing information to commuters from a single kiosk in Bellevue.

Recently, there have been two local public information efforts that will impact this project. First, the Washington State Department of Information Services implemented a pilot project providing public information through kiosks. This project, Washington Information Network (WIN), was established to help the state government serve the people of Washington State better, faster and more cost-effectively. These kiosks provide a public interface to several government databases including transportation and recreation. The impact this effort will have on this project is the local experience gained through its design and implementation; several issues including data security, communications protocol as well as public experience with the kiosks have already been addressed.

Second, WSDOT presently maintains several home pages on the world wide web. They provide information such as real-time traffic congestion information for the greater Seattle freeways and transit access information for the greater Seattle area. These home pages represent excellent sources of traveler information that have established formats and communications protocol (i.e. TCP/IP).

Although traveler information kiosks represent relatively well proven technology, they have not been widely used for recreational information applications. As such it is important to first demonstrate the feasibility and evaluate the potential of a recreational kiosk a wider application can be advanced. These kiosks would provide static information providing route instructions to tourist attractions, tourist attraction times of operation and local services information.

Statement of Deficiency:

Tourists and infrequent travelers to remote areas are unfamiliar with the services and attractions the area has to offer. In addition, advertisements and signing cannot convey all the desired information. A medium that can provide information on local services, local attractions and route instructions would provide focus for the market interested in that information.

Project Description:

The project will demonstrate a tourist-oriented kiosk at a remote location near both attractions and services. This will allow for an evaluation of the feasibility of expanding the scope of this project to rest areas along the I-5 corridor. The project will involve the custom development of a user interface, screen format and control software suitable for providing static tourist information.

With the assistance of groups such as the Lewis County Trade and Economic Development Group, the United States Forest Service, the National Parks Service, the FHWA, the Western Federal Lands, data will be compiled that will assist tourists in locating tourist attractions and local services. This data will populate the kiosk's database which will be updated infrequently (e.g. once a month) either remotely or by field staff. This data includes attraction locations, operations times, route instructions, and local services (i.e. restaurants, accommodations and tourist-oriented stores).

System Capabilities:

The proposed project will have the following capabilities:

- Provide a personal and accessible interface by which travelers can request information using a touch screen, a pointing device and a keyboard and view this information using a color monitor, clear sound-generating equipment and a printer; and

- Provide static tourist information including attraction locations and hours of operation, route selection and local services information.

Project Scope: The project scope will involve two phases. The first phase will develop the kiosk interface, screen format, kiosk database and communications. The second phase will implement and evaluate the kiosk. The following is a brief description of the tasks of each phase.

Phase 1: Develop and Deploy Interface and Format

The first phase will consist of the following tasks:

1. Compiling kiosk information from meetings with interested groups and agreements made with local services.

2. Arranging a partnership with a commercial interest in order to locate the kiosk; this commercial interest would receive free advertising in return for space rental and maintenance of the kiosk.

3. Coordinating with the Washington Information Network (WIN) design to facilitate development of similar interface.

4. Completing design of the kiosk including interface, communications, database format, and method to update information.

Phase 2: Implementation and Evaluation of Kiosk

Phase 2 will implement and evaluate the kiosk as developed in the previous phase. The following tasks are included in this phase:

1. Selecting equipment that meets the specifications of the design.

2. Purchasing and installing the kiosk and communications hardware.

3. Developing and customizing the software for the kiosk.

4. Testing and evaluating the kiosk.

5. Evaluation of performance and use of the kiosk.

Project Cost: Table 1 presents a summary explanation of the capital cost in 1995 dollars for the Pilot Rest Stop Information Kiosk. The estimate is for the base system which was described above and does not include the planned expansions and upgrades. The design and evaluation cost is estimated at 20% of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10% of the capital cost.

Total Capital Cost	$45,600
Annual O&M	$4,560

Project Benefits: The project benefits are expected to derive from the fact that the number of tourists visiting the tourist attractions and local services will increase due to the kiosks advertising. As a result, local service providers and other commercial interests will provide cost-sharing and other revenue to participate.

The Statewide IVHS Plan identified the potential annual benefits for rural applications of traveler information as $17,880. Considering the proximity of the tourist services to the proposed location, it is assumed that 10% of the benefits apply to this application yielding $1,788 annually. In addition, advertising sales and private cost-sharing will offset the operations of the kiosk. These are anticipated to be $5,000 each annually.

Annual Benefits	$11,788

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are assumed to be uniform for the 20 year period.

Equivalent Uniform	
Annual Costs	$7,916
Annual Benefits	$11,788
Benefit/Cost Ratio	1.5:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 years time frame). The planning and design phase (phase 1) of the project will be completed in six (6) months after award. The implementation phase (phase 2) will be completed in eighteen (18) months after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Kiosk Hardware and Software (including CPU with keyboard, pointing device, touch screen, color monitor, multi-media capability, modem and printer)	35,000	1	35,000
Kiosk Cabinet	3,000	1	3,000
Total Construction Cost	-	-	38,000
Design/Evaluation Cost	-	-	7,600
Total Capital Cost	-	-	45,600
O & M Cost/Year	-	-	4,560

Table 1: Cost Summary

Project Title:	Develop and Deploy WSDOT Southwest Region Traffic Related Information System
User Services:	Travel and Transportation Management En-Route Driver Information Traveler Services Information Travel Demand Management Pre-Trip Travel Information Demand Management and Operations
Time Frame:	Near Term
Objective:	To develop a traffic related event-based Advanced Traveler Information System (ATIS), and deploy it in the Southwest Region along the I-5 Corridor.
Project Background and Need:	Advanced Traveler Information Systems have proven to be one of the most effective ITS tools for managing traffic, reducing congestion, delay, fuel consumption and emissions, and improving safety. This is achieved by informing travelers of the location of incidents, construction and traffic congestion in order to allow travelers to choose alternative routes, modes or departure times. Currently there exists within the Southwest Region along the corridor a number of sources of traffic related event information such as incident reports, construction and maintenance activities, traffic congestion and location of detours. While some of this information is distributed to the public through variable message signs (VMS), highway advisory radio (HAR) and media reports, much of it is used for internal agency purposes only and/or is not readily accessible by the public. There is therefore a need to develop a system that can collect and aggregate these various sources of information in order to provide travelers with a comprehensive, single source of traffic related information that can be accessed on a pre-trip or en-route basis using a variety of means and technologies. In addition, such a system would provide a consistent basis for defining traffic events, further improving the value of the information to the public, other transportation agencies and commercial vehicle operations.

Statement of Deficiency:

The management of traffic in a congestion area, in a work zone, or at an incident location requires the timely transmission of event related traffic information to travelers on a pre-trip and en-route basis. Limited access to current traffic-event related information hinders the ability to manage traffic in these areas, with the result of increased congestion levels, decreased mobility, and a subsequent impairment of traffic safety.

Project Description:

This project would involve the development and deployment of a system to collect, process, format and disseminate traffic related information for the Southwest Region. This information could also be consolidated and filtered to provide input to a comprehensive corridor or statewide information system. For example, a Traffic Related Traveler Information System will be developed to facilitate coordination between this region with both the Olympic Region.

Development, implementation, integration and operations costs will be minimized by developing a similar system for all three Regions in the Northwest Region project. Only minor custom tailoring and configuring for this Region would be required to accommodate Region-specific information sources, dissemination methods and operational strategies.

System Capabilities:

The Traffic Related Traveler Information System will manually or electronically gather traffic related event information such as:

- accident and incident reports from such sources as cellular phone or other call-ins, police dispatch, WSDOT mobile vehicles and the bridge tenders;
- pre-planned road closure, construction and maintenance information;
- emergency road closure, construction and maintenance information;
- truck or hazardous material restrictions;
- reversible lane operations;
- weather conditions;
- information on planned recreational events or other activities that may disrupt traffic flow or require traffic re-routing.

All information inputs will need to be geocoded using a common referencing system such as latitude-longitude, highway milepost or major street-cross street.

Information will be stored in a relational database, running as an application on a desktop PC using a multi-tasking operating system such as Windows NT. Maximum use of commercial off-the-shelf (COTS) software, coupled with a modular design approach, will allow for a system that is expandable (both functionally and geographically) and transportable to other applications or to new hardware platforms.

The system will be designed to disseminate the traffic related event information through existing and planned WSDOT motorist information devices (i.e. VMS, HAR and media interfaces). Information dissemination capabilities may also be expanded to include new devices such as:

- automatic fax transmission to WSDOT maintenance yards, commercial radio and television stations, and other public and/or private users in need of regular traffic reports. Subscribers to the fax service would be able to define the type of information they want, the geographical area, the highways and the times (including immediate response) at which faxes should be sent. It would also be possible to charge for this service, which would be part of the subscribers data base.

- alphanumeric pager messages to WSDOT operations and maintenance staff and emergency services;

- a public dial-up information line providing computer-generated voice messages. The messages could be structured so that they can be accessed by the highway name for selected geographical areas (e.g. I-5 FROM TACOMA TO SEATTLE);

- linkages to traveler information kiosks;

- computer data feeds to both public and private users through Internet and/or direct dial-up lines;

- data feeds to mobile units using data formats such as the International Traveler Information Interchange Standards (ITIS) over radio based communications including subcarrier, CDPD or data broadcast radio;

- electronic data interfaces to value added re-sellers including HELP

Inc. for redistribution of the information to truckers along the corridor.

For this Region, it is anticipated that the system will be initially integrated into existing traffic engineering and/or roadway maintenance operations. Terminal feeds from regional maintenance yards would also be provided to allow remote access throughout the Region.

Project Scope: Work activities will consist of two phases:

Phase 1 - Deploying and configuring the traffic related traveler information system in the Southwest Region.

Phase 2 - Facilitating a communications link to the Seattle-Portland Traffic Related Traveler Information System Center.

This work will not include the deployment of traveler information devices (e.g. VMS, HAR, information kiosks, etc.) in the field. It is expected that these will be installed as part of other initiatives.
It is expected that the design and development of the traffic related traveler information system for the Northwest Region will form the standard for all Regions in the corridor. As such, this project must begin after the completion of the first phase of the Northwest Region project.

<u>Phase 1 - Deployment in the Southwest Region</u>

Upon successful development and testing of the traffic related event information system in the Northwest Region, the system would be deployed and modified in the Southwest Region. Major work activities in this Region will include:

1. Preparation of a functional design report describing aspects of the Northwest Region system that need to be tailored for application in the Southwest Region;

2. Detailed design of modifications to the Northwest Region system software elements to support deployment in the Southwest Region;

3. Hardware and software procurement/additional license agreements;

4. Modification or development, coding and testing of modified or new software applications.

5. Modification and testing of hardware/software interfaces to existing WSDOT systems (e.g. VMS).

6. Development and testing of new hardware/software interfaces to external users. Application or modification of interagency agreements developed for the Northwest Region to each major external user;

7. Overall system testing and integration.

8. Update of design, operations and maintenance manuals;

9. Training of operations staff.

Phase 2 - Integration with Seattle-Portland Traffic Related Information System

This second phase would facilitate a communications link to the Seattle-Portland Traffic Related Traveler Information System Center to assist in providing corridor wide traveler information coverage. This activity could be done concurrently with system deployment of the corridor-wide system, or could be deferred until sufficient experience is gained with stand-alone operation in this Region

Requirements and provisions for providing corridor wide information will have been considered under the Northwest Region system core design. Work under this phase will consist mainly of relatively minor software and/or hardware modifications including:

1. Preparation of a system design report;

2. Procuring additional software/licenses for the digital maps or GIS to provide corridor wide coverage.

3. Preparing inter-Regional agreements for the sharing and exchange of information, including establishing levels of access.

4. Modifying existing external agency agreements as required to

provide corridor information, and establishment of new agreements with agencies having a corridor focus (e.g. private CVO firms).

5. Establishing system-to-system data communications links using the Internet-based corridor system architecture.

6. Modifying system software as required to support corridor wide information collection and dissemination.

7. Update of design, operations and maintenance manuals;

8. Training of operations staff.

Project Cost: Estimated project costs are described in Table 1 and are summarized below. The costs include the software development and limited hardware procurement. These costs do not include additional field equipment such as VMS's, pagers, kiosks, etc. It is expected that these will be provided as part of other initiatives.

It is assumed that the system will be staffed by one full-time equivalent performing both operations and maintenance. It is assumed that the operations and maintenance is 20% of the capital cost. It is assumed that communications will be provided through existing resources (i.e. SCAN or radio).

Total Capital Cost	$180,000
Annual O&M	$36,000

Project Benefits: The Statewide IVHS Plan identified the potential benefits of ATIS in the Vancouver area at approximately $7,500,000 per year. Assuming that 5% of these benefits can be achieved through deployment of the Southwest Regional Traffic Related Information System, the annual benefits for the Southwest Region can be estimated as:

Annual Benefits	$375,000

Project B/C: The benefit/cost ratio is based on a 20-year amortization of capital and O&M costs, and the pro-rated ATIS benefits computed in the Statewide IVHS Plan. The assumed rate of return is 4%, which is consistent with the computation methodology used in the Statewide IVHS Plan.

Equivalent Uniform Annual Costs	$49,248
Annual Benefits	$375,000
Benefit/Cost Ratio	7.6:1

Project Schedule: The Southwest Region Traffic Related Information System is proposed as a high-priority near-term project (0-6 years time frame). The system development would be based on the core system design developed for the Northwest Region Traffic Related Information System. System development would be completed in six (6) months after award. The system deployment would be completed one (1) year after award.

It is expected that the system design and deployment of the system in the Northwest Region be completed first. Deployment of similar system in the Southwest and Olympic Regions is contingent upon the successful deployment in the Northwest Region. The three systems are expected to be integrated into a corridor-wide system after all three systems have been deployed.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
System Deployment	150,000	1	150,000
Total Construction Cost	-	-	150,000
Design/Evaluation Cost	-	-	30,000
Total Capital Cost	-	-	180,000
O & M Cost/Year	-	-	36,000

Table 1: Cost Summary

Project Title: Develop and Deploy WSDOT Southwest Region SC&DI System

User Services:

Travel and Transportation Management:
- En-Route Driver Information
- Route Guidance
- Traffic Control
- Incident Management

Travel Demand Management:
- Pre-Trip Travel Information

Commercial Vehicle Operations:
- Commercial Fleet Management

Public Transportation Operations:
- Public Transportation Management

Emergency Management:
- Emergency Vehicle Management

Time Frame: Near Term

Objective: The primary objective of this effort is to improve the safety and efficiency of people and goods movement on the urban freeway network through the deployment of a surveillance, control, and driver information (SC&DI) system in the Vancouver area along Interstate 5, Interstate 205, and State Route 14.

Project Background and Needs: Interstate 5 serves as the primary highway connection between Seattle and Portland and is part of the major interstate route which runs from Canada to Mexico along the west coast of the United States. I-5 travels through downtown Portland and crosses the Columbia River (state line) via two 3-lane bridges entering Clark County. Approximately 13 miles south of downtown Portland, I-205 begins an eastern loop around Portland acting as an important bypass route around the central core of the city. I-205 crosses the Columbia River six miles to the east of I-5. I-5 and I-205 intersect at I-5 Exit 7. Washington State Route 14 (SR 14) connects both interstate facilities along the north shore of the Columbia River.

The Portland Regionwide Advanced Traffic Management System Plan (Oregon Department of Transportation, 1993) is part of an intelligent transportation system (ITS) strategy to address regional growth and its impacts on the transportation system. This regional planning effort was undertaken to develop a master plan for the implementation of an Advanced Traffic Management System. The project steering committee included representatives from ODOT, WSDOT, FHWA, Portland, and METRO (Metropolitan Planning Organization). The ATMS integrates

the management of various roadway functions including freeway SC&DI and arterial signal control. This plan developed an 18-year implementation plan which calls for the establishment of a centralized Traffic Management Operations Center (TMOC). The TMOC would be the center for communications among the agencies in both Washington and Oregon.

Statement of Deficiency: Traveler delay, caused or exacerbated by congestion, is on the rise in the Portland-Vancouver region. The potential exists for the number of lane miles of congestion to increase 300 percent and travel speeds on Portland-Vancouver region's travel corridors to decrease nearly 30 percent.

Project Description: This project would involve the development and deployment of a surveillance, control, and driver information system in the Vancouver area along the I-5, I-205, and SR 14 corridors. This effort would be coordinated and integrated with the Oregon Department of Transportation's Portland Regionwide Advanced Traffic Management System (ATMS). The SC&DI will provide closed circuit television (CCTV) cameras, variable message signs (VMS), and ramp meter installations in the Vancouver area.

The control units for the signals, CCTV, VMS, and ramp meters will be located at the Traffic Management Operations Center (TMOC) in Portland, Oregon. Direct data lines would also be provided in the TMOC that would allow direct monitoring and control of the Vancouver VMS, CCTV and ramp meters. The Southwest Region has indicated that they would consider providing this capability in order to assist with regional traffic management initiatives.

System Capabilities: The proposed Vancouver Area SC&DI System will have the following capabilities:

- Monitor real time traffic conditions along I-5, I-205, and SR 14 using the CCTV system;
- Control the Vancouver area VMS to display either pre-designed messages or other messages in response to regional traffic conditions;
- Coordinate operations with the Portland TMOC and the Washington State Patrol for regional traffic management; and
- Coordinate operations with other WSDOT TSMC's.

Project Scope: The project will be divided into two phases: the planning and design phase and the near-term implementation phase. Following is a brief description of the scope of work for each of the two phases.

Phase 1: Planning and Design of Vancouver Area SC&DI

The planning and design effort will consist of the following activities:

1. Review of the Portland Regionwide Advance Traffic Management System Plan in the context of new initiatives. The plan would be updated if required.

2. Design a Closed Circuit Television (CCTV) system which will include developing specifications for the cameras, housing, Pan, Tilt, and Zoom (PTZ) unit and display monitors. The design will include determining the exact location and designing the mounting for each camera unit. The System Plan suggests that 28 CCTV cameras be installed along I-5 (10 cameras), I-205 (11 cameras), and SR 14 (7 cameras) over the next 20 years.

3. Design a variable message sign (VMS) system. The design will include developing specifications for the signs and the head-end support system, determining the exact location of the signs, and developing a message library. The signs would be controlled from the TSMC. This effort includes converting two existing VMS to Type 170 based controllers. The messages displayed on the VMS will be coordinated with Portland's TMOC. At least two (2) variable message signs would be installed over the near and mid term time frames - one on I-5 and the other on SR 14.

4. Design the ramp-meter system. This effort will include developing specifications for the loops, signal display, warning signs and flashing beacons, control cabinet, output/power distribution assembly, as well as the display monitor and software at the TSMC. The design will also include determining the exact location and designing the ramp meter installation. The System Plan suggests that twenty (20) ramp meters be installed at 13 on-ramps along I-5 and 7 on-ramps along I-205 over the next 20 years.

5. Design the communication system to interconnect the field equipment, including the CCTV's, traffic control signals, local controllers, and VMS's to the TSMC. This effort will also include designing the interface and communications systems requirements between the TSMC and the Portland TMOC, Washington State Patrol, and other WSDOT TSMC's.

6. Plan and design the Vancouver area Traffic System Management Center (TSMC). This effort includes determining a location for the TSMC, determining space and personnel requirements, and the layout. The effort will also include the design of both the hardware and software of the main workstations.

7. Plan for interconnections and expansion of the system to include the following:

    - interconnection to public transportation systems;
    - transit priority system;
    - CVO applications;
    - emergency notification interface;
    - WSDOT baseline advanced traveler information system;
    - weather information system;
    - port access system; and
    - regional multi-modal traveler information center.

All of these additional applications will have the standard interfaces required based on the statewide architecture adopted as part of this project. The TSMC will have the ability to display information provided by each one of these applications using the standardized interface.

Phase 2: Implementation and Evaluation of Vancouver Area SC&DI

The second phase of this project is the implementation and evaluation of the Vancouver area SC&DI system. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Construction of the TSMC. This effort would include purchasing and installing the TSMC's equipment;

5. Developing/customizing the software for field equipment and head-end configuration;

6. Integrating the Vancouver area SC&DI system into the Portland region ATMS;

7. Develop operational procedures;

8. Testing and evaluating the system; and

9. Evaluating the performance of the system in terms of reductions in traffic congestion, fuel consumption, travel time, and accidents.

Project Cost: Table 1 presents a summary of the capital costs in 1995 dollars for the Vancouver area SC&DI system deployment over the next 20 years. The estimate is for the base system which was described above and does not include planned expansions or upgrades, The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$35,533,200
Annual O&M	$3,553,320

Project Benefits: The project benefits are expected to be a reduction in traveler delay caused by congestion and a reduction in incidents. The Statewide IVHS Plan identifies the potential benefits in the Vancouver as approximately $7,500,000 for ATIS, $9,200,000 for VMS, $5,400,000 for HAR, $5,400,000 for CCTV, $16,300,000 for incident management, and $17,600,000 for detection. These benefits total to roughly $61,000,000 for the Vancouver region. Urban roadways (the Vancouver area) represent 75% of the vehicle-miles traveled in Clark County. This yield an annual benefit of:

Annual Benefits	$45,750,000

Project B/C: The benefit/cost analysis is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4%. Both the expected benefits and the operations and maintenance costs are uniform for the 20 year period.

Equivalent Uniform	
Annual Costs	$6,168,564
Annual Benefits	$45,750,000
Benefit/Cost Ratio	7.4:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the SC&DI system will follow

in both the medium-term and long-term time frames. These costs have been included in the cost estimate.

The planning and design phase (phase 1) of the project would be completed eighteen (18) months after award. The implementation phase (phase 2) would be completed six (6) years after award.

Item	Unit Cost (1995 $)	# Units	Total Cost (1995 $)
Data Stations	50,000	44	2,200,000
CCTV System	50,000	28	1,400,000
Variable Message Signs	195,000	2	390,000
Ramp Meters	55,000	20	1,100,000
Communication System	24,521,000	1	24,521,000
Total Construction Cost			29,611,000
Design/Evaluation Cost			5,922,200
Total Capital Cost			35,533,200
O & M Cost / Year			3,553,320

Table 1: Cost Summary

Project Title: Deploy Ice Detection System

User Services:
Travel and Transportation Management:
En-Route Driver Information
Incident Management
Travel Demand Management:
Pre-Trip Travel Information
Emergency Management:
Emergency Vehicle Management

Time Frame: Near Term

Objective: To plan, design and implement ice detection and warning systems at selected locations along Interstate 5. These systems would be integrated into the three regional surveillance control and driver information (SC&DI) systems. This effort should reduce vehicle accidents along I-5 by providing timely and road-specific weather information and forecasts to drivers, WSDOT maintenance personnel, and the Washington State Patrol.

Project Background and Need: Analysis of accident data reveals two locations along I-5 between Seattle and Portland which experience a relatively high level of ice-related accidents. The first location is in the vicinity of the bridge across the Burlington Northern Railroad tracks at MP 83 near Centralia. The other location is in vicinity of the Puyallup River bridge at MP 135 in Tacoma. At these two locations, ice-related accidents make up about 17 percent of the total number of accidents. These accidents result in fatalities, injuries, and property damage and are also a primary cause of non-recurrent congestion in the corridor. The societal cost of ice-related accidents at each of these locations is approximately $210,000 per year.

At this time, decisions regarding ice build-up on roadways result from a reaction to current conditions, or at best, a supposition based on a media forecast of inclement weather or other indications. Forces are mobilized, perhaps first by instituting patrolling to check conditions or by changing shift schedules. Often a supervisor will get word that roads have become icy. The supervisor sends out crews to respond to problems as they occur, and these crews remain in the field until the problems have subsided.

Statement of Deficiency: Current weather forecasting is not effective in predicting when ice forms at two bridges along I-5. Ice-related accidents result in fatalities, injuries, and property damage as well as delays to roadway users.

Project Description: The project will include planning, designing, implementing and evaluating ice detection and warning systems along I-5 at the following locations:

- BN Railroad Bridge MP 86 (Southwest Region)
- Puyallup River MP 135 (Olympic Region)

Major components include the Road Weather Information System, the Value-Added Meteorological Service (VAMS), and the Communications System link to the two planned regional Traffic System Management Centers (TSMC).

Road Weather Information System (RWIS)

The RWIS will detect and monitor road weather conditions through field sensing equipment, processing software, and communications equipment that are linked by dial-up leased telephone company lines to a central computer located at the regional TSMC.

Within the RWIS internal communication scheme, the combination of sensors, microprocessor, power supply, and modem is called a remote processing unit (RPU) station. The RPU processes raw data from each of the sensors available at each site. This data is then transmitted automatically from the RPU via dial-up leased telephone company lines to a workstation located at the planned TSMC. The workstation transmits data to WSDOT's maintenance offices and the VAMS for archiving and display.

Value-Added Meteorological Service (VAMS)

Tailored weather forecasts will be provided by a VAMS via the communications system to the three regional TSMC's. The VAMS would develop site-specific forecast models for each of the two locations. The models will use data provided by the National Weather Service's Next Generation Weather Radar (NEXRAD) Information Dissemination System and real-time RPU data to provide tailored forecasts for the coming twenty-four hours with scheduled updates and/or updates whenever the conditions or the forecast changes. Tailored weather forecasts will be provided by VAMS via the communications system to the users.

Communications System

RPU's will be stand-alone systems. The RPU will be connected to the workstation by dial-up leased telephone company lines. Sensor data will be sent to the workstation at regular intervals and updates whenever the

conditions change. The workstation will be able to poll the RPU. When ice is detected on the road surface, the RPU will signal the VMS to display the required message to drivers and signal the workstation about the change in weather conditions. The workstation will also be able to signal the VMS to display messages and/or to override the RPU's commands to the VMS.

The ITS Backbone is an important component of the RWIS and will be used for disseminating and acquiring RWIS information. Communication includes:

- the transmission of data from regional workstation to regional workstation and workstation's to users;
- the dissemination of road condition information to police, road users, and the traveling public;
- the acquisition of weather information by VAMS, which includes National Weather Service-disseminated data, RWIS data, and data from other remote monitoring sources; and
- the communication of RWIS forecasts and information between forecasters (VAMS) and users.

SC&DI System

The ice detection and warning system will be integrated into the planned regional SC&DI systems. The RWIS would be controlled and operated by personnel located at the Southwest and Olympic Region's planned TSMC's. Operators would use the workstation's access capabilities to ensure that the RPU's and sensors are operating and providing satisfactory data in relation to each other. These operators also provide data about weather and roadway conditions, personnel, equipment, and materials problems to the next higher level of administration.

Information regarding road conditions would be disseminated to drivers, WSDOT maintenance personnel, and the Washington State Patrol. Travelers would be informed of road weather conditions by variable message signs (VMS). VMS would be installed in advance of problem locations. These VMS would be controlled by RPU with override capabilities provided to the workstation. At some locations, VMS which are part of the regions' SC&DI system, will be utilized. These VMS will be integrated into the ice detection and warning system. Highway maintenance personnel would be contacted by radio, telephone or via the communication system. The Washington State Patrol would be informed of weather conditions via their liaison at the TSMC.

System Capabilities: The proposed Ice Detection and Warning System will have the following capabilities:

- the transmission of data from sensors to RPU's, RPU's to workstation's, and workstation's to users;
- the dissemination of road condition information to drivers, WSDOT maintenance crews, and the Washington State Patrol;
- the acquisition of weather information by VAMS, which includes National Weather Service-disseminated data, RWIS data, and data from other remote monitoring sources;
- the communication of RWIS forecasts and information between forecasters (VAMS) and users; and
- the development of an archival data base for each RPU.

Project Scope: The project will be divided into two phases: the planning and design phase and the near-term implementation phase. Following is a brief description of the scope of work for each of the three phases.

Phase 1: Planning and Design of RWIS-Ice Detection

The planning and design effort will consist of the following activities:

1. Develop the user information needs and associated data requirements.

2. Design the remote processing unit (RPU) stations. The design will include designing the sensor suites; developing specifications for sensor suites, RPU's, and the head-end support system at the planned TSMC or to workstations at the regional offices; and determining the exact locations for sensors and RPU's at the two locations. The effort will include designing power connections for each RPU. At least two (2) remote processing unit stations would be required - one for each bridge.

3. Design a variable message sign (VMS) system. The design will include developing specifications for the signs and the head-end support system, determining the exact location of the signs, and developing a message library. The signs would be controlled from the RPU's with override powers provided to the regional TSMC. The messages displayed on the VMS will be coordinated with the regional TSMC. VMS would be in advance of potential ice hazards. Approximately four (4) variable message signs would be required - two for each bridge.

4. Design the central processing unit (workstation). This effort will include the design of both the hardware and software requirements of the main workstations. This design includes determining the space and personnel requirements for operating the workstation in the regional TSMC. Two (2) central processing units would be required - one for each region.

5. Develop and design the Value-Added Meteorological Service (VAMS). This effort includes developing the site-specific weather forecast models for the two locations. Hardware and software requirements for the VAMS will also be designed. The design includes determining a location for the VAMS, determining the space and personnel requirements, and the layout. The VAMS will be connected to all three workstation's at each of the regional TSMC. One (1) Value-Added Meteorological Service would be required.

6. Design the communication system to interconnect the field equipment, including the sensors, RPU's and VMS's to the workstation located at the regional TSMC. This effort will also include designing the interface and communications requirements between the workstation and the VAMS, WSDOT maintenance crews, and the Washington State Patrol. The VAMS will be connected all three TSMC's.

7. Plan for future upgrade and expansion of the system to include the following:

    - integration with the flood detection and warning systems;
    - integration with the fog detection and warning systems;
    - addition of highway advisory radio (HAR);
    - addition of RPU's at a spacing of 20 miles along I-5;
    - interface with the state-wide ATIS system to provide traveler information including weather information and road conditions; and
    - interface with public transit operators to provide information about weather and road conditions.

Phase 2: Implementation and Evaluation of RWIS-Ice Detection

The second phase of this project is the implementation and evaluation of the ice detection and warning system. This will include the following activities:

1. Selecting equipment that meets the specification of the design;

2. Purchasing and installing field equipment;

3. Purchasing and installing the communications hardware;

4. Purchasing and installing equipment for the two TSMC's;

5. Setting up a VAMS. This includes purchasing and installing equipment;

6. Developing/customizing the software for field equipment and head-end configuration at the TSMC's and VAMS;

7. Testing and evaluating the system; and

8. Testing and evaluating the system in terms of reducing ice-related accidents and improving the efficiency and effectiveness as well as reducing the cost of highway winter maintenance practices.

Project Cost: Table 1 presents a summary of the capital costs in 1995 $ for the Ice Detection and Warning System. The estimate is for the base system which was described above and does not include the planned expansions or upgrades, The design and evaluation cost is estimated at 20 percent of the construction cost. The annual Operations and Maintenance (O&M) cost is estimated at 10 percent of the capital cost.

Total Capital Cost	$1,068,000
Annual O&M	$106,800

Project Benefits: The project benefits are expected to concentrate on the net reduction in accidents and reduced costs in the highway winter maintenance program. The benefits are estimated as a function of the reduction in accidents. The proposed improvements would result in a reduction of about 30 percent in the number of ice-related accidents at these two locations. The societal benefits would be equivalent to about $914,000 per year.

Annual Benefits	$914,000

Project B/C: The benefit/cost is based on a 20-year amortization of construction and engineering costs plus operations and maintenance. The discount rate is 4 percent. The following costs are in 1995 dollars.

Equivalent Uniform Annual Costs	$185,400
Annual Benefits	$914,000

Benefit/Cost Ratio 4.9:1

Project Schedule: The project is proposed as a near-term ITS project (0-6 year time frame). Follow-up projects to expand and upgrade the ice detection and warning system will follow in both the near-term and medium-term time frames.

The planning and design phase (phase 1) of the project would be completed twelve (12) months after award. The implementation phase (phase 2) would be completed twenty-four (24) months after award.

Item	Unit Cost (1995 $)	Number of Units	Total Cost (1995 $)
RPU Station	70,000	2	140,000
VMS	120,000	4	480,000
Workstation	10,000	2	20,000
VAMS	200,000	1	200,000
Software	100,000	1	100,000
Interface Requirements	50,000	1	50,000
Communications	100,000	1	100,000
Total Construction Cost			890,000
Design/Evaluation Cost			178,000
Total Capital Cost			1,068,000
O & M Cost / Year			106,800

Table 1: Cost Summary

APPENDIX C

COMMUNICATION PROJECT PROSPECTUSES

This appendix contains the individual project prospectuses identified in Technical Memorandum Number 5: Recommended Corridor Communication alternatives. These projects included in this appendix are listed below.

NEAR-TERM PROJECTS

Project Title
Seattle TSMC to the I-405 Interchange
I-405 Interchange to the King-Pierce County Line
King-Pierce County Line to the Olympic Region TOC
Vancouver Area
Assess Public/Private Partnerships
Develop an Emergency Preparedness Plan

This document is not available in electronic format. For more information, contact;

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